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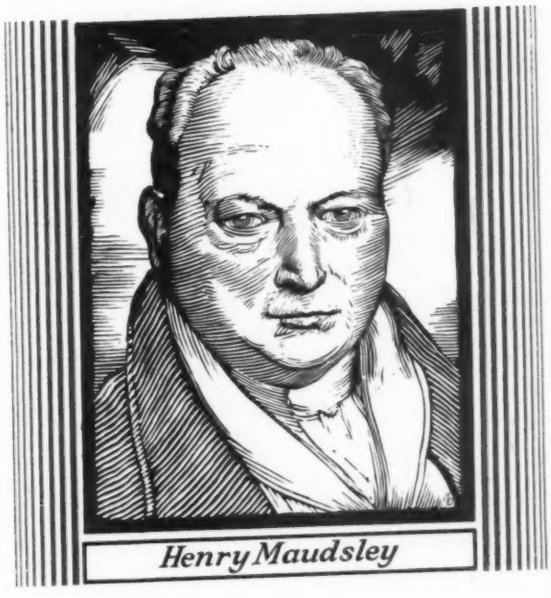
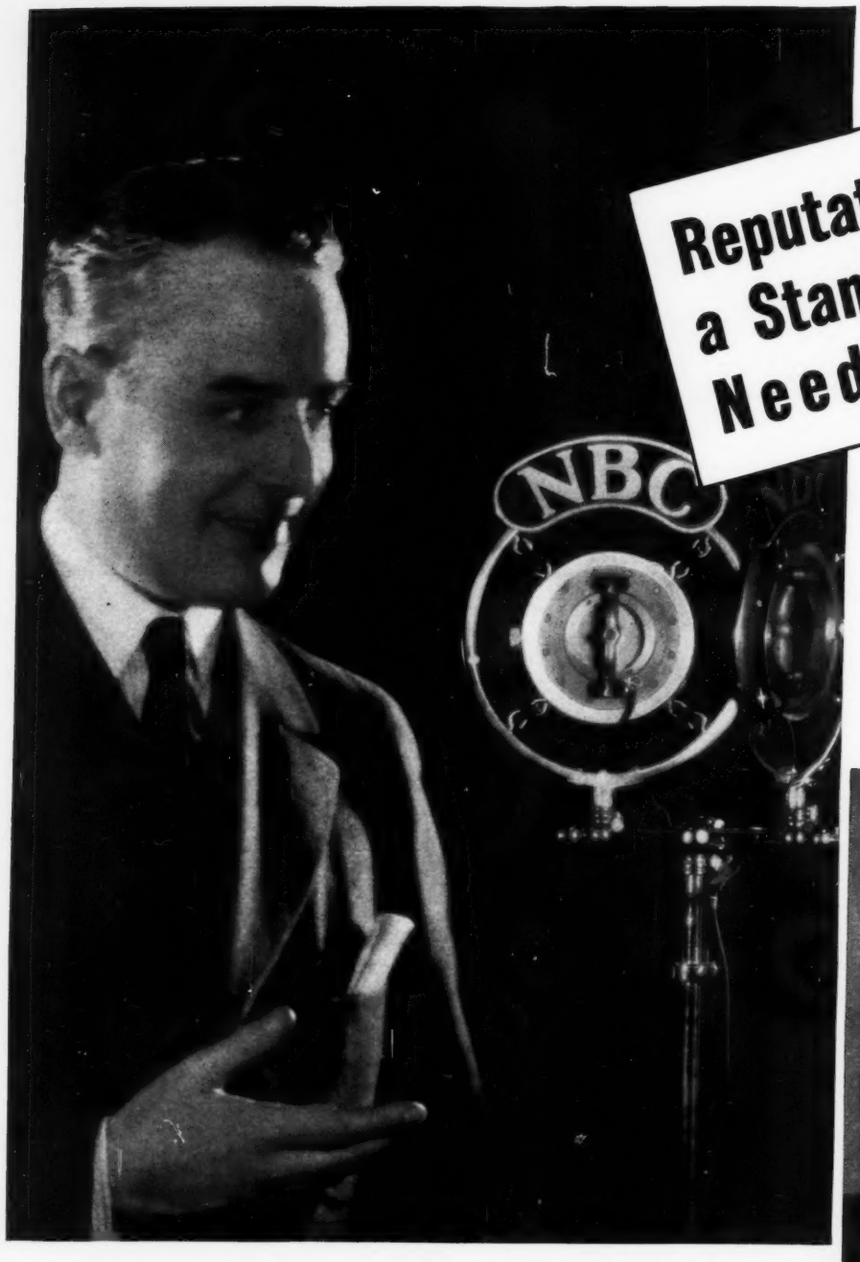
MACHINE DESIGN



Henry Maudsley

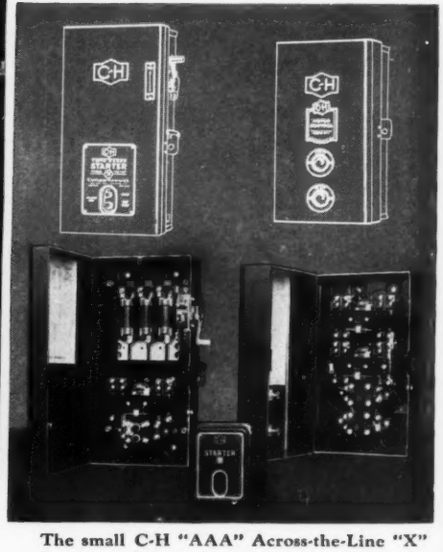
AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES



Reputation Erects a Standard Others Need Not Meet

Stars of the stage are invariably specialists. Only specialization makes possible that perfection of technique which the world is willing to recognize as outstanding performance.



The small C-H "AAA" Across-the-Line "X" Starter and two of many variations. *To left:* with Safety Switch; *to right:* a reversing starter.

The Leader is Always a Specialist

Reputation holds the eyes of the world on the leader. Each performance is a crisis. Where others are applauded for occasional prowess, exceptional performance is *expected* of the leader every time.

Thinking executives recognize this important fact. They realize that Cutler-Hammer, leaders in Motor Control for more than three decades, *must* build to an unvarying high standard. Knowing the importance of modern Motor Control in attaining low cost, unhalting production, they insist on Cutler-Hammer control for every motor drive.

Leading machinery builders incorporate Cutler-Hammer Motor Control. Farsighted motor builders recommend it. Progressive electrical wholesalers carry it for your convenience. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1310 St. Paul Ave., Milwaukee, Wisconsin.

CUTLER HAMMER

The Control Equipment Good Electric Motors Deserve

(A-801)

Itemized Index for June, 1933

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

Design Calculations:
Horsepower of gears, Edit. 27

Design Problems:
Compactness, obtaining, Edit. 16R, 17L
Die castings, considering, Edit. 18, 19, 20, 21
Engine, locating, Edit. 22, 62
Packings, choosing correct, Edit. 29, 30, 39
Performance, determining, Edit. 23, 24, 25, 26
Replacements, simplifying, Edit. 11, 12, 13, 14
Shift lever, eliminating, Edit. 15, 16L
Steel, specifying, Edit. 33
Testing moving parts, Edit. 23, 24, 25, 26
Thinking, organizing, Edit. 31, 32
Unitization, applying, Edit. 11, 12, 13, 14
Weight, distributing properly, Edit. 22, 62
Welding, designing for, Edit. 16, 33

Materials:
Alloys (Iron), Edit. 41R
Alloys (Nickel), Adv. 51
Alloys (Steel), Edit. 58R; Adv. 10
Aluminum, Edit. 18, 19, 20, 21
Bronze, Edit. 18, 19
Cork, Edit. 29, 30
Felt, Edit. 29, 30
Leather, Edit. 29, 30, 39
Steel, Edit. 33
Zinc, Edit. 18, 19, 20, 21

Mechanisms:
Cam, Edit. 13, 14, 47
Clutch, Edit. 13R, 14
Controlling, Edit. 17
Driving, Edit. 15, 16L
Lever, Edit. 13, 14
Metering, Edit. 16R

Parts:
Bearings, Edit. 38; Adv. 4, 52L, 68
Cast parts, Edit. 40R, 41R
Clutches, Edit. 13R, 14, 15R, 48, 56R, 58R
Controls (Electrical), Edit. 49, 50, 58R; Adv. 2
Cords (Electrical), Edit. 49R, 50L
Drives, Edit. 15, 16L, 27R, 28L, 50R, 52R, 54R, 56R, 62R; Adv. 3, 9, 53, 62, 63
Electronic equipment, Edit. 16R, 17L, 49L
Fastenings, Edit. 38L, 47R, 48L; Adv. 58L
Forgings, Edit. 33
Gears, Edit. 15, 16L, 27, 28, 37, 38L
Heating units, Adv. 65R
Lubrication and lubricating equipment, Adv. 57
Motors, Edit. 52R, 54R; Adv. 6, 61
Plugs (Electrical), Adv. 54L
Pumps, Edit. 50L, 52R, 56R; Adv. 56L, 64L
Springs, Edit. 47
Stampings, Edit. 45R
Steel balls, Edit. 47R, 48L
Valves, Edit. 17
Welded parts and equipment, Edit. 16, 28, 33, 45R; Adv. 67

Principles:
Centrifugal, Edit. 48

Production:
Die castings, specifying, Edit. 18, 19, 20, 21

Standardization:
Bushings, Edit. 38
Inquiry sheets, Edit. 28
Preferred series of numbers, Edit. 27R, 28L
Thread symbols, Edit. 38L

COMPLETE automaticity is reaching out into new fields and overcoming the obstacles placed in its path by the continuous addition of controls to the machine. The lead in this trend has been taken by the automotive designer who has perfected mechanisms which eliminate the gearshift lever. Elimination of controls extends further, however, as Austin M. Wolf will bring out in an article in July which will be most useful to all phases of machine design.

CALENDAR OF MEETINGS AND EXPOSITIONS

June 12-15—National Association of Purchasing Agents. Exposition and annual meeting at Hotel Statler, Boston. G. A. Renard, 11 Park Place, New York, secretary.

June 12-16—American Oil Burner association. Annual meeting and exposition at Stevens hotel, Chicago. H. F. Tapp, 342 Madison avenue, New York, secretary.

June 12-16—Water Works Manufacturers association. Annual meeting and exhibition at Hotel Sherman, Chicago. J. A. Kienle, 250 Park avenue, New York, secretary.

June 14-16—American Institute of Chemical Engineers. Semiannual meeting at Medinah Athletic club, Chicago. F. L. LeMaistre, 808 Bellvue Court building, Philadelphia, secretary.

June 19-21—Scientific Apparatus Makers of America. Annual meeting at Marraine lodge, Highland Park, Ill. J. M. Roberts, 100 North LaSalle Street, Chicago, secretary.

June 19-23—Confectioner's National exposition. Annual meeting of National Confectioner's associaton of the United States at Hotel Sherman, Chicago. F. S. Records, 111 West Washington street, Chicago, secretary.

June 20-23—American Foundrymen's association. Annual meeting will include technical papers on "Dynamic Properties of Steel Castings as Determined by the Impact Test," by Fred Grotts, "High Strength, Wear Resistant Malleable Iron," by Rebecca Hall, and "High Silicon, Heat Resisting Cast Iron," by A. L. Norbury and H. H. Morgan. C. E. Hoyt, 222 West Adams street, Chicago, secretary.

June 21-24—American Society of Agricultural Engineers. Annual meeting at Purdue university, Lafayette, Ind., will include papers on "Motor Control and Protective Devices," by H. J. Gallagher and "Equipment Designed for Orchard Tillage," by O. W. Sjogren. Raymond Olney, St. Joseph, Mich., secretary.

June 22-24—American Society of Heating and Ventilating Engineers. Semiannual meeting at Hotel Statler, Detroit. A. V. Hutchinson, 51 Madison avenue, New York, secretary.

June 26-28—Industrial Marketing conference. Eleventh annual meeting of Industrial Advertisers' association at Medinah Athletic club, Chicago, will include an exhibit of successful industrial advertising on many products. R. H. Bacon, 537 South Dearborn street, Chicago, can supply further information.

June 26-28—Institute of Radio Engineers. Annual meeting at Hotel Sherman, Chicago. H. P. Westman, 33 West Thirty-ninth street, New York, secretary.

June 26-30—American Institute of Electrical Engineers. Semiannual meeting at Edgewater Beach hotel, Chicago. H. H. Henline, 33 West Thirty-ninth street, New York, secretary.

June 26-30—A Century of Progress. This week has been designated as Engineer's Week at the World's Fair and June 28 has been set aside as Engineer's Day. Twelve national engineering societies are meeting and a number of expositions are scheduled during this period. Information on the fair may be obtained from the management at Burnham Park, Chicago.

June 26-30—American Society for Testing Materials. Thirty-sixth annual meeting at Stevens hotel, Chicago, will include technical papers on "The Fatigue Properties of Light Metals and Alloys," by R. L. Templin, "An 'Overnight' Test for Determining Endurance Limit," by H. F. Moore and H. B. Wishart, "A Comparison of Certain White Metal Bearing Alloys Particularly at Elevated Temperatures," by C. E. Swartz and A. J. Phillips, and a symposium on cast iron. C. L. Warwick, 1315 Spruce street, Philadelphia, secretary.

June 26-30—American Society of Mechanical Engineers. Papers to be presented at semiannual meeting at Palmer House, Chicago, will include: "The Application and Performance of Compressed Air in Woodworking Machinery," by R. F. Onsrud; "Developments of Cast Iron for Machine Construction," by O. Smalley and W. W. Kerlin; "Final Report on Research on Heavy Duty Antifriction Bearings," by W. Trinks and J. H. Hitchcock; and "Factors to be Considered in the Substitution of a Different Material in the Product," by J. L. Alden. Calvin W. Rice, 29 West Thirty-ninth street. New York, secretary.

June 27-29—Sixth Midwest Engineering and Power exposition. At Stevens hotel, Chicago. Exposition headquarters at 308 West Washington street, Chicago.

June 27-30—Society of Industrial Engineers. Annual meeting at Stevens hotel, Chicago. George C. Dent, 205 West Wacker Drive, Chicago, secretary.

MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
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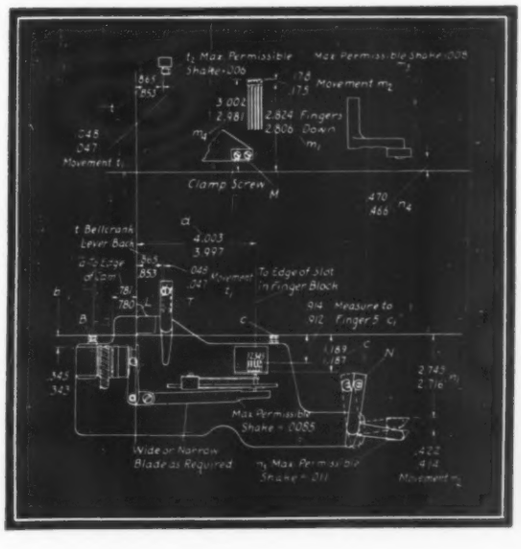
Unitized Design as Applied to Teleprinters

By R. D. Salmon
Creed & Co. Ltd., Croydon, England

and

Arthur H. Adams
Consulting Engineer, New York

Fig. 1—(Above)—Machine which transmits telegrams over a telegraph wire is designed with interchangeable units. Fig. 2—(Below)—Functional drawing of the cam unit



UNITIZATION is the extension of the idea of machines built with interchangeable parts, to machines built with interchangeable units. This method of design was presented fully in the article "Unitization—Logical Sequence to Interchangeability of Parts," on page 29 of the December, 1932, issue of MACHINE DESIGN. The purpose of the present article is to show how the idea can be applied in general and how it has been used specifically in the design of the Creed Teleprinter, Fig. 1.

When commencing the design of a machine on the lines of unit construction it is necessary, after having finished the rough experimental models, to determine the natural boundaries between the different sections of the machine so as to break it up into convenient units. There are two extremes between which it is possible to work. On the one hand a machine can be built almost in one piece with all the small parts fixed to one common base plate, the base plate being provided with all kinds of lugs and pillars so as to reduce the number of separate parts to a minimum. On the other hand the base plate can be a simple casting with all the work-

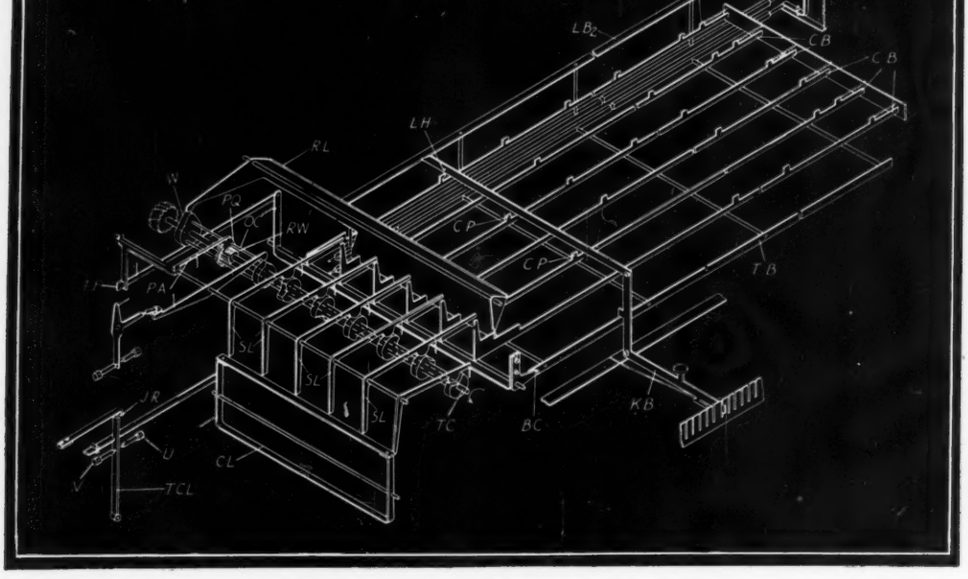


Fig. 3—Keyboard transmitter with front to back dimensions greatly spread for visibility. Keybars actually move vertically on roller guides not shown and have very short horizontal overhang

ing parts built up separately upon it. Or a middle course can be taken, grouping all the working parts on to a number of small castings or stampings, each one being designed to reduce the number of built-up parts to a minimum.

Having determined the natural boundaries between the different parts of the machine it is desirable to make a master functional drawing of the machine showing all the moving parts together with the possible variation in the amount of movement, the amount of backlash in the movement if any, and the actual limit of the range of movement. These three factors are determined by a study of the limits which it is proposed to allow on the individual piece parts. These will include the maximum and minimum clearances between pivots and their bearings, the limits allowed between center distances and also the limits allowed on the actual shape of the piece parts. A study of this master diagram will show the maximum limits which can be allowed on all measurements. After the piece part drawings are prepared, functional drawings of each unit are made similar to Fig. 2, and functional gages must be designed to check the dimensions specified on the functional drawings.

Example of Functional Drawing

Fig. 2, a typical functional drawing of a unit, gives the results of the study of the three factors—movement, backlash and range—with tolerances arrived at for the working surfaces or ends of the moving parts in the teleprinter unit called the cam unit. Against the end of each lever where it engages adjacent units limiting dimensions are given which show the lever in one extreme position of its movement, also the amount of movement required and the maximum permissible shake. Thus the dimension n_1 shows the limits allowable in one extreme position. These limits are arrived at by considering the individual limits of all the piece parts concerned. The limit given in the amount of movement n_2 allows for the variation in the amount of rise on the cam track controlling this lever, and the maximum permissible shake n_3 takes into consideration the shake allowed on each pivot over which the motion is transmitted.

Exhaustive Tests Made

When the individual units have been passed in their functional gages they are assembled into complete machines and then are examined to a specification giving the relationships that should obtain between all co-operating parts of the mechanism. The complete machine then should be given a suitable operating test to eliminate any unit having faults. Each teleprinter, for example, has to print an absolutely errorless seven-hour record from signals sent by a standard transmitter. If an error is found the trouble is diagnosed, the faulty unit replaced, and the seven-hour run recommenced.

Before considering the design for unitization in detail, it might be well to understand in a general way the working principles of the machine. The teleprinter, Fig. 1, is designed to transmit telegrams over a telegraph wire by the direct operation of a keyboard similar to that of an

ordinary typewriter. The messages are received in the form of printed characters, and the machine can be used in business offices where it is to be operated by a stenographer without special training.

The machine operates in accordance with the start-stop principle of telegraphy, employing the standard start-stop code consisting of a starting signal, five combination signals forming the intelligence code, and a stopping signal. In this system, synchronism between transmitting and receiving shafts is sustained by a rough form of phase correction which will maintain satisfactory operation between two teleprinters even though the motor speeds differ by approximately 7 per cent.

Keyboard Transmitter Generates Signals

The signals are generated by a keyboard transmitter, as in Fig. 3, (purely diagrammatic) which comprises a number of vertically sliding keybars such as *KB*, five combination bars *CB*

Fig. 4—Before final assembly, the dimensions of each unit are checked on a functional gage such as this one being used to check the combination unit

under the control of the keybars through lugs *CP*, a transmitting cam *TC* controlling five selector levers *SL*, a common operating lever *CL* and a single transmitting lever *TCL* working between two fixed contacts *U* and *V*. The transmitting cam is adapted to be driven by a one-revolution clutch *OC*, under the control of a trip bar *TB* which is operated by depressing any key.

Controls Endwise Movement

Upon the depression of any key, the trip bar *TB* releases the transmitting cam *TC*. The rotation of the transmitting cam first releases the common returning lever *RL* which controls the endways movement of the combination bars.

This allows those bars which have not been held by the depressed keybar to move to the right under the action of their springs. The telegraphic signal required therefore is represented by the relative endways position of the combination bars.

Further movement of the transmitter cam releases the selector levers *SL* one after the other and these are allowed to move or are prevented from moving, according to the endways position of the corresponding combination bar, *CB*. The movement of the selector levers operates the common lever *CL* against the action of its returning spring which thus moves the transmitting contact. The transmitting contact is provided with a jockey roller *JR* which reduces the transit time to a minimum and holds the transmitting contact firmly against one or the other of the fixed contacts as may be required until it is definitely moved to the other one under the influence of the common lever.

In order to insure accurate operation of the keyboard, two locking bars are provided. The bar LB_1, Fig. 3, is arranged to hold the key which has been depressed by catching hole *LH* until the transmission of the five combination signals has been effected, and the other LB_2 is arranged to prevent the depression of a second key until the first key has been released. These locking bars also are controlled by the lever marked *RL*.

One Revolution Clutch Used

As only one group of signals may be sent for each depression of a key, no matter how long that key may be held down, the transmitter cam is arranged to be driven under the control of the one revolution clutch shown diagrammatically in Fig. 5. Letters used to designate parts indicate the same part in Fig. 3.

When trip bar *TB*, Fig. 5, is depressed by keybar *KB*, bellcrank *BC* lifts pawl abutment *PA* out of engagement with pawl *PQ*. Thus this pawl is allowed to engage with the rotating ratchet shaft. As this rotates, cam *W* presses link *TF* out of engagement with pawl abutment *PA* which thus is allowed to move back into the path of the pawl abutment so as to retract it

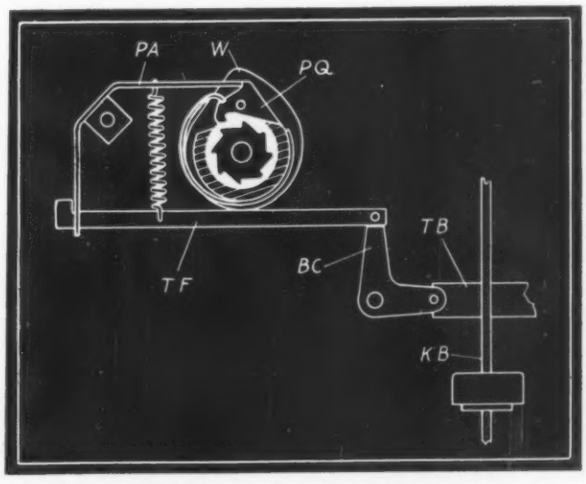


Fig. 5—One-revolution clutch is employed to insure that only one set of signals is sent at the same time

from the ratchet wheel at the end of the revolution. Before the cam can be released a second time, the trip bar *TB* must be raised so as to re-engage link *TF* with the pawl abutment *PA*.

The signals generated by the mechanism described in the foregoing operate the receiving magnet which in turn controls the receiving portion of the machine, Fig. 6. This comprises the receiving magnet *RA*, the receiving cam, the selecting mechanism, the translating mechanism, the printing mechanism and the paper carriage.

The selecting mechanism comprises the striker pin *SP*, the striker blade *SB* and the selector fingers SF_1-SF_5. The pin is arranged to be moved in front of the selector fingers by the receiving cam *RCS* so as to be opposite to the first selector finger during the receipt of the first combination signal, and opposite to the second, third, fourth and fifth fingers during the receipt of the following combination signals respectively.

The striker blade *SB* is arranged to be operated under the control of the receiving cam so as to make a forward striking movement against the striker pin *SP* during the receipt of the central portion of each combination signal.

Magnet Controls Striker

It also is arranged to be moved up and down under the control of the receiving magnet *RA* so as to be opposite to the striker pin when the relay armature is in a position corresponding to a marking signal and to be below the level of the striker pin when the relay is in a position corresponding to a spacing signal. Thus, for a marking signal the operation of the striker blade moves the striker pin so as to set the corresponding selector finger, but during the spacing signals the striker blade moves below the striker pin and the corresponding finger is not set. By this means the selector fingers are caused to take up positions corresponding to the setting of the combination bars on the transmitter whose signals are being received. The fingers at the proper instant are slightly raised by the cam. Their positions then determine whether the combination disks described in the following are left normal or slightly rotated, for those fingers that were set by the striker pin will hit, and the others will miss the horizontally extending arms of these disks.

The translating mechanism comprises five combination disks, CD_1-CD_5, provided with slots cut on their periphery against which selector bellcranks *BK* are caused to bear under the action of springs *BS*. The slots are cut so that for every possible setting of the combination disks, one or other of the selector bellcranks will be able to fall into an aligned set of slots.

Bellcranks Catch Type Wheel

The type wheel, which is driven by a friction clutch *CF*, Fig. 6, is provided with a stop arm *SA* adapted to be caught by any selector bellcrank which has fallen into an aligned set of slots so as to be arrested and thus bring opposite to the printing hammer the type bar required. The printing hammer *PH* is under the control of the receiving cam and is adapted to make a printing stroke after the type wheel *TH* has come to rest and thus to print the required letter upon the paper carried by the paper carriage. In addition to the five combination disks, a sixth disk *SC* is provided which is under the control of the figure and letter shift bellcranks in order to give the type wheel 62 possible positions.

The printing is affected upon a sheet or web of paper carried by a paper carriage, which is moved endways in a step-by-step manner for every letter received. This movement winds up a spring contained in a spring drum which acts to return the carriage to the beginning of the line when it is released by the carriage return signal.

How the principles of unitization work out in practice, the requirements which have to be met, and the means of achieving the result required will be described in the second article on the teleprinter, next month.

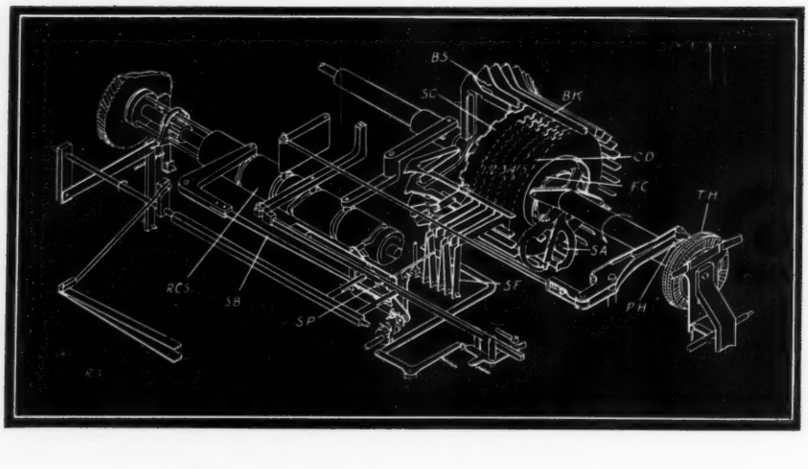


Fig. 6—Striker pin in receiving portion of printing telegraph machine sets the selector fingers so that they will rotate the proper disks and thus drop the proper bellcranks into position to catch the type wheel where the letter or numeral selector will print

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Shift Lever Is Going!

TRUE to forecasts made from time to time in these columns over the past two years the auto gearshift lever has met its doom. The Reo Motor Car Co. is installing a self-shifting transmission as standard equipment on its new Reo Royale. This innovation marks another progressive step in the history of automotive engineering and augments its reputation as a pace setter in the mechanical industries. No doubt the influence will spread into other fields as designers watch the public's acceptance. Automaticity is a powerful selling point.

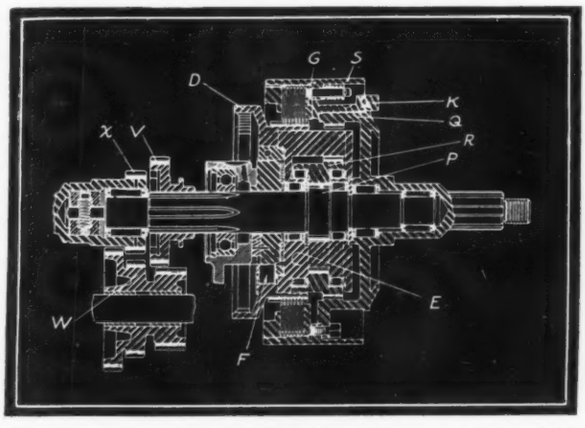


Fig. 1—Automatic transmission by the use of which gearshift lever has been eliminated

The mechanical shifting transmission unit, Fig. 1, has four basic gear ratios, only two of which are employed for normal driving conditions. A selector or control handle at the instrument panel controls the forward gearset (*V* a sliding gear, *W* countershaft gears, *X* main drive gear) shown in neutral position in Fig. 1. Pushed all the way in the control handle sets the transmission in "forward"; part way out "neutral," and all the way back "emergency low range." When the control handle is turned to the right and pulled entirely back the car is in reverse.

In starting, the clutch pedal is depressed, the transmission shifted in "forward" through the control handle and the pedal released. As the accelerator is depressed the transmission goes into "low-high." When the car reaches 10 to 15 miles an hour a centrifugal clutch gradually engages "high gear" or direct. So smooth is the shift into direct that acceleration is completely continuous, only the gradual reduction in engine speed serving to indicate that the shift is being made.

When the control handle is in "forward" position gear *V*, Fig. 1, on the spline shaft slides over the main drive gear *X*, effecting a drive to the center of the automatic unit through its integral gear *P*, Fig. 1, which is meshed with the internal and external gear *R*. Countershaft gears *W* move forward out of the way. Gear *R* in turn rotates the main gear *Q* and outer drum *S* of the automatic unit. Gear *Q* is connected direct to the propeller shaft and drives the automobile.

Overrunning Clutch Employed

Operation of the internal train of gears may be more clearly understood by referring to Fig. 2. Gear *R* is carried on a pair of roller bearings in an eccentric assembly (shown at *E*, Fig. 1). Natural tendency would be for gear *R* to rotate in a reverse direction around gear *P* because of resistance set up in its driving main gear *Q* which is connected direct to the drive shaft. To offset this action an overrunning clutch *F*, Fig. 1, is located at the forward part of the assembly, which prevents the inner drum *D* and the eccentric assembly from turning backwards during the operation of the internal gear train. Thus all power is applied direct to main gear *Q* through the reduction gears.

Eight governor weights *K* around the circumference of the drum *S*, Fig. 2, tend to move outward by centrifugal force as the car speed increases. At approximately 14 miles per hour these weights pivot at their forward ends and

smoothly engage and lock the multiple disks, Fig. 1, through pressure plate *G*. This action causes the outer and inner drum assemblies to rotate with the spline shaft as a unit with no gear reduction, thereby placing the transmission in high or direct drive.

If the control handle is in emergency low position countershaft gears *W* are moved back, the forward gear meshing with the main drive gear *X*, and the second gear meshing with the sliding gear *V*. A reduction then is effected through these gears as well as the regular internal gear reduction in the automatic transmission. If when driving through these two reductions the car speed reaches approximately 14 miles per hour, the automatic unit will change into the "emergency" direct drive. It will of course, stay in these gears until the control handle or selector is moved to the forward normal position, shifting the forward gears into direct drive. In reverse the sliding gear *V* and countershaft gears *W* are moved back, engaging through a reverse idler gear.

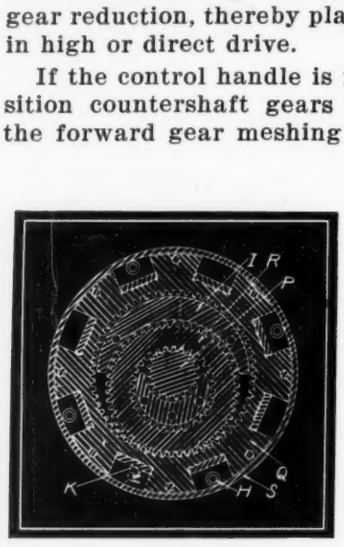


Fig. 2—Counterweights controlled by centrifugal force are actuated to effect direct drive

Welding Without Grooving

SINCE welding has become an important factor in the design of machinery it behooves engineers to keep abreast of developments. Accordingly the introduction of an innovation in arc welding particularly suited to joining heavy plates is worthy of study. Known as Murex straight gap welding the new process of Metal & Thermit Corp., New York, eliminates the need for veeing or grooving plate edges.

Plates to be joined are lined up with the welding edges parallel. A steel backing strip ⅛-inch thick is used to close the bottom of the gap. An initial layer of weld metal which seals the lower edges of the gap first is applied, the electrode being moved from side to side in the gap while welding and tilted to wash away some of the plate edge. When building up is completed an annealing layer is placed over the top, backing strip removed, the first layer of metal gouged out, and the weld finished by running one or more layers, and also an annealing layer on the under side.

Keeping the Customer Satisfied

MORE recent among innovations in the design of gasoline dispensing pumps is a computing device, replacing the conventional dial, which automatically measures and registers the smallest fraction of a gallon and computes the cost as the fuel is delivered. Where gasoline is sold at prices involving fractions of a cent this unit, developed by Wayne Co., Fort Wayne, Ind., is particularly advantageous. The motoring public also is becoming dollar minded and to customers wishing to see registered the cost of fuel the pump is a boon. It now will be easy to order "a dollar's worth."

The pump, Fig. 3, represents an interesting engineering development, the outgrowth of careful study of a growing market which already has reached tremendous proportions. Computing mechanism is comprised of a series of gears which by changing speed will compute, in conjunction with a variator or counter, the price of a sale from one-tenth of a cent to 55 cents. No clutch or ratchet mechanisms are employed and adjustment for different prices can be made is less than a minute. This unit provides another example of a changing design trend to meet new conditions and requirements.

Fig. 3—This new type gasoline pump which measures and registers the smallest fraction of a gallon and computes the total cost as the fuel is delivered in full view of the customer will appeal to the motoring public

Mirrors Aid Compact Design

ENGINEERS are looking to the photoelectric tube as a solution to their problems involving conservation of space. This is impressively illustrated by a photoelectric installation on a conveyor at the National Enamel & Stamping

Co., Granite City, Ill. Here a G. E. relay is employed at the end of the conveyor, Fig. 4, to prevent enameled ware from piling up at that point. When any operator applying beading to the ware misses a piece, it interrupts the beam of light, automatically shutting off the motor.

Note the unique arrangement employed to save space. The light source and phototube are mounted underneath the conveyor, the light beam being focused vertically. By means of two mirrors this beam is reflected across the surface of the conveyor belt and then downward to the phototube.

Before the installation of this relay the operation was performed by a mechanically-operated limit switch. The objection was that the mechanical device marred the ware, making it necessary to wash and redip any piece which

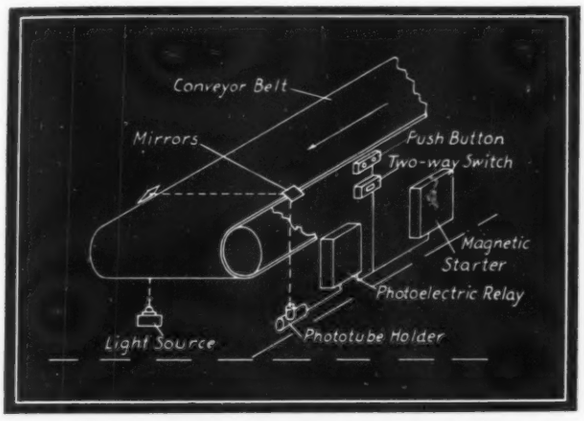


Fig. 4—By mounting the phototube and light source under the conveyor space is conserved

stopped the conveyor. Then, too, very light pieces failed to operate the limit switch. Though simple, the ideas involved in this arrangement are worthy of designers' attention.

New System Tames Wild Beer

TO THE brewery engineer has fallen the task of taming "wild" beer, a condition which follows rolling of a new barrel into position and tapping it. Wildness also develops in drawing from the barrel through pipes and coils to the glass. Excessive foaming is the result, with waste of both beer and natural carbonic gas.

One of the leading authorities on brewing equipment, Edward Zahm, has invented a new controlled-pressure beer drawing and cooling system for the Liquid Carbonic Corp., Chicago. The principle is amazingly simple. Instead of coils led through the cooler, a silver-lined tank or cylinder 30 inches high and 6 inches in diameter, Fig. 5, holds the beverage. This unit is installed within the insulated walls of the cooler.

Incoming supply of beer enters the tank near the top, settles, cools and is drawn off quietly from the bottom. The heart of the entire system is the counter pressure valve at the top of the unit. By this automatic device beer is allowed to flow at the same pressure at all times

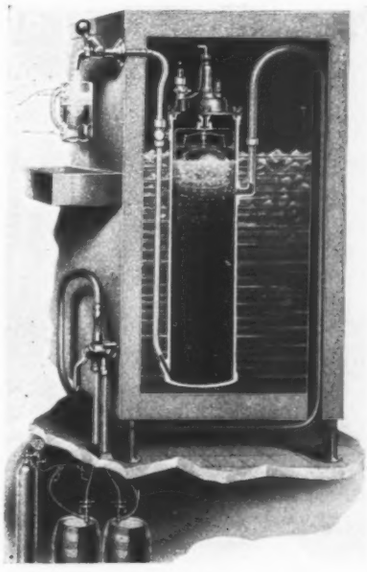


Fig. 5—Controlled-pressure system for dispensing beer embodies a tank which is equivalent to the brewer's settling vat where beer loses its wildness

regardless of the condition of the beer in the barrels. Constant regulated pressure ovecomes the familiar problem of a different "collar" on a glass from a half empty barrel compared with a glass from a full barrel. Warm beer at the top constantly replaces cold beer drawn from the bottom. The three-gallon capacity of the unit keeps a full supply of cooled beer. Even with steady withdrawal of the entire supply the new beer has been cooled below 40 degrees when it emerges at the bottom.

This unit is a fitting substitution for the old-time skilled bartender whose technique in drawing beer was nothing short of amazing. The designer of this type of equipment must constantly keep in mind that there is a marked dearth of experience among the present-day handlers of brewery products and equipment.

Substitutes Textile for Metal

AMONG exhibits at this year's spring Fair at Leipzig, Germany, was a novel fan which employs blades of limp silk ribbon instead of metal. These ribbons stretch out and stiffen under the influence of centrifugal force when the fan is in operation. No guard is used inasmuch as possibility of injury from accidental touch is obviated. It will be remembered that on page 16 of the May issue a unique method of eliminating the hiss of fan blades was presented.

Considering Design from the Production Sta

By Harold F. Shepherd

and

W. J. During

Part VII—Die Casting

EXAMINATIONS of many specimens of die casting will reveal that a special technique of design has been developed, particularly in cases where the manufacturer has been privileged to negotiate with the user to secure favorable conditions for production. Other specimens indicate that the mold maker has been too willing to expend great ingenuity in contriving means of overcoming difficulties unwittingly introduced by the designer.

Die casting design is governed by some of the considerations discussed in the article on founding (Part I of this series, M. D., Dec. 1932). The necessity of providing means for removing the piece from a two-part mold is primary. If the mold is not literally a two-piece structure all core mechanisms should at least be part of one half-assembly or the other.

Loose pieces in the mold are even more to be avoided than in designs for founding in sand. The mold is reassembled hot after each cycle, an operation which naturally should be performed mechanically, even automatically. This is difficult, if not impossible, when the inner part of the mold assembles like a jig-saw puzzle. Special cases such as stencil roll castings, however, may justify such complications.

The molten metal under pressure penetrates every crevice while the mold cannot be made quite fluid tight since it must work freely over a reasonable temperature range. Loose interior parts naturally tend to admit fins that delay mold action or at least mar the appearance of the product. Time is an important factor in maintaining the proper working temperature of the mold to avoid cold shots and swirls. Constancy of operation is essential for the avoidance of scrap.

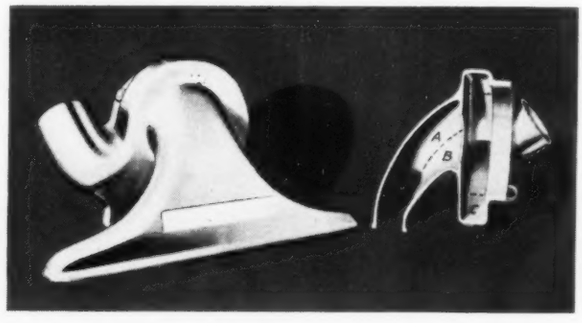


Fig. 2—(Above)—Intricate coring required for vacuum cleaner nozzle and fan chamber is practical when objective is sufficiently attractive. Fig. 3—(Right)—Six of these pieces are left loose in the casting after the molding is completed

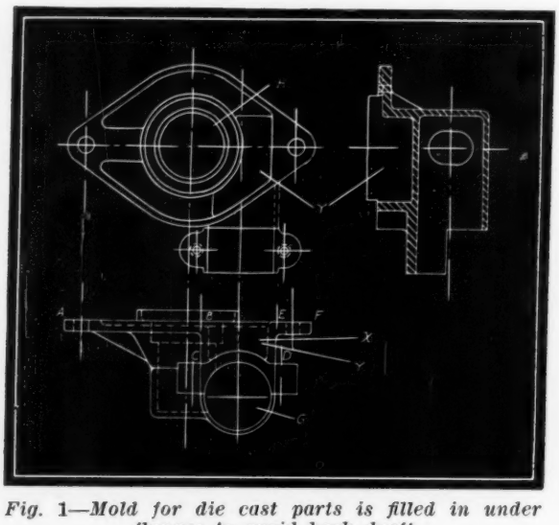


Fig. 1—Mold for die cast parts is filled in under flanges to avoid back draft

In sand molding great license is allowed in designing the interior geometry of castings since the core is broken up for removal. Metal cores a different problem entirely. The die casting should be designed so that the cores may be drawn from the mold by mechanism before the casting is ejected. Conceivably, collapsible cores such as are used for some aluminum pis-

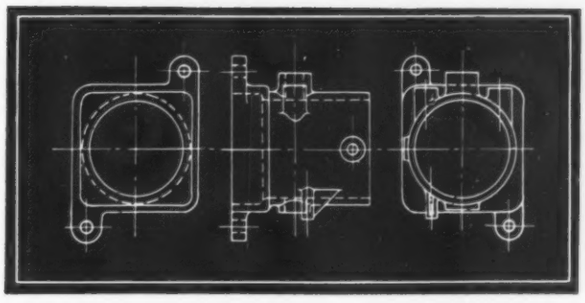
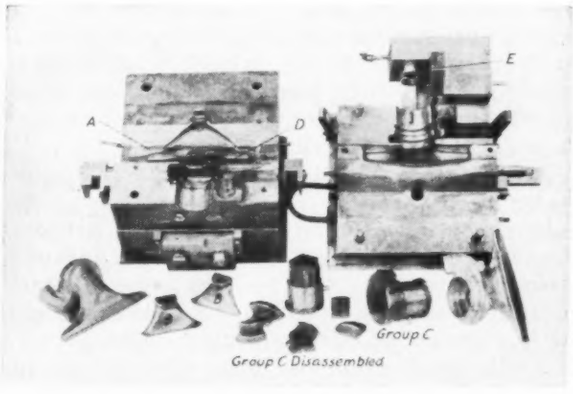


Fig. 4—Careful design shows studied orientation of all lugs and bosses at right angles to parting or with it

tion Standpoint

ton castings might be employed, but only at the expense of the difficulties described in connection with loose pieces in the mold. In machine die casting, cores that may be withdrawn by a simple direct pull through the joint or side of the mold are best practice, although in many cases this is not possible.

While it always is desirable to adhere to the simpler designs in the interest of economy it is practicable, where the objective is sufficiently



Group C Disassembled

attractive and quantities permit, to do almost anything in the way of intricate coring. A case in point is illustrated by the vacuum cleaner nozzle and fan chamber in Figs. 2 and 3. Section *A*, Fig. 2, was cored by radial core *A*, Fig. 3, and undercut. Section *B*, Fig. 2, was formed by the lower piece *B*, Fig. 3, which remains in the casting after radial core *A* is withdrawn. Undercut section *C*, Fig. 2, is formed by five loose pieces and a hub as shown disassembled and assembled in group *C*, Fig. 3. The gate hole, through which the metal is fed into the edge of the nozzle is readily discernible on the right hand section of Fig. 3.

In preparing to make the casting, insert *B*, Fig. 2, is placed in position at *D* in the mold, and group *C* is assembled and placed on extractor *E*. After the mold is filled, core pulley *E* extracts the center hub shown in group *C*, leaving five loose pieces together with the single loose piece *B* in the casting. These parts are so designed that they can be removed readily, and by using a spare set sufficient casting speed is attained to make production by this procedure comparatively economical.

In one respect die casting presents a possibility not welcomed in sand casting. This is offsetting the mold joint. Since the drag half of a sand mold is rammed up in an inverted position, irregular or offset joints do not lend themselves well to follow board or match plate work on machines. The die casting mold is used in the assembled condition and while offsets may make some slight expansion troubles in mold manipulation, and perhaps allow some leakage of molten metal, they may be used without serious consequence.

All Cores Draft Outwardly

The casting shown in Fig. 1 is made in such a mold. Note the fill-in under the flange at *X* to avoid back draft. The parting follows the line *A-B-C-D-E-F* on this side. Note also the coring at *Y* which is desirable to avoid shrink cavities and unnecessary weight. All the cores in this piece draft outwardly, the lateral core *G* kissing the axial core *H* in such fashion that when *G* is drawn *H* is released.

In the carburetor part Fig. 4 is shown the studied orientation of all lugs and bosses, eight in number, either at right angles to the parting or with it to avoid back draft in the mold. The boss *J* on the engine pan Fig. 7, is a lateral projection and the special core *K* is required with automatic wedge retractor *L* to operate it. The inclined oil drain core *M* is manipulated by a rack cut on its shank and meshing with a pinion bar on a lever, a characteristic manual mechanism.

The same forethought that was recommended in the design of forgings, (M. D., Jan.) applies equally well to die castings. The detail designer should vision as nearly as he is able the machining of the mold and avoid as far as pos-

sible any shapes that cannot be produced on machine tools. This may be more difficult than designing for drop forging since castings usually unite a number of parts, but it is well worth trying. For instance, many molds are profiled on a vertical milling machine, and round corners of the mill radius may be quite as satisfactory as square ones. Yet failure to consider this may result in days of hand labor on the mold.

Little, sometimes no draft, is used in shallow molds for the softer alloys of lead or zinc base. It is said that small parts of zinc base metals can be produced to an accuracy of 0.001-inch per inch of length and even less per inch of diameter. Such accuracy is only possible, however, at the expense of experimental refinishing of dies to compensate for the indeterminate die expansion and casting shrinkage. It should be specified only at need.

Shrinkage Is a Serious Problem

Shrinkage is a much more serious problem in casting aluminum. The inclined end of the engine pan, Fig. 7, coupled with prompt mold opening and automatic ejection of the casting favor this problem. Numerous cores for bolts resisting the shrinkage make it more difficult. Such cores should have ample draft. If not capable of destructive resistance to casting shrinkage, small cores of this sort may be broken themselves.

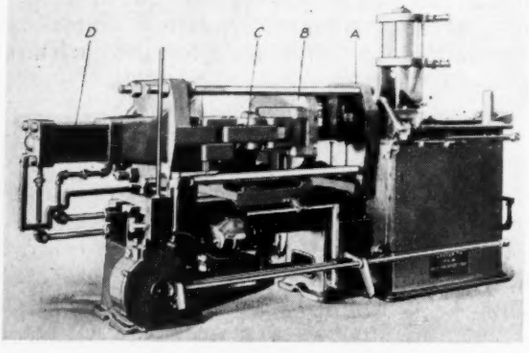


Fig. 5—Hydraulic-type die casting unit is protected against bursting by toggles

General rules for draft on aluminum die castings call for 0.015 to 0.020-inch diametral draft per inch of length for holes less than ⅛-inch diameter. From ⅛ to 1 inch, use 0.010-inch diametral draft per inch of length, and over one inch, 0.010 to 0.030 inch.

Die castings in aluminum have reached 40 inches in length while parts two feet long are fairly common. Sections of these large parts may be as little as 0.090 to 0.100 inch thick. For transverse dimensions of not over six inches the thickness may be 0.060 to 0.075 inch. Aluminum

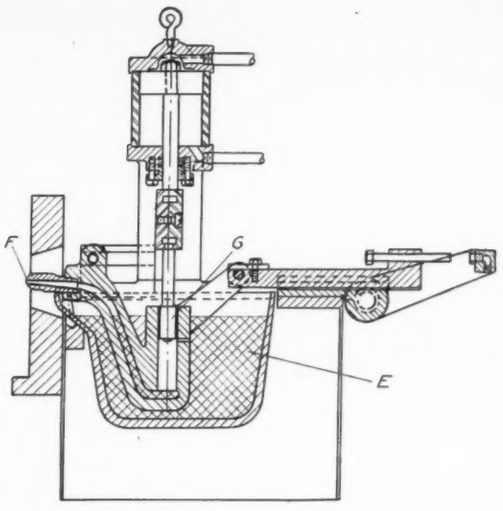


Fig. 6—Metal is forced home by hydraulic actuation in die casting aluminum and similar alloys

castings of only 0.025 to 0.030 inch thickness have been produced. Limits given are:

Normal to parting + 0.010 — 0.000
over all
Transverse dimensions + 0.003 —
0.000 over all

Closer limits are possible for special work when dies are corrected after trial.

Die casting alloys of all classes have had special study. The zinc alloys have been made chemically stable and are available in various degrees of hardness and ductility. They shrink on metal inserts firmly where dual properties are required in one casting. Zinc and lead alloy castings are rendering satisfactory service in a great many devices.

Aluminum alloy die castings extend the economies of the process to parts requiring mechanical properties of another order. Brass and bronze die castings are the center of intense research activity at the present time. The accomplishments to date are so encouraging that early removal of the remaining obstacles to real quantity production not only of ordinary forms but of the more intricate and heavier type of castings may be anticipated.

Safety Precautions Necessary

As areas, pressures and temperatures mount, the hazards of using die casting machinery are increased proportionately. Not only is a powerful mold closing mechanism necessary to provide against the inadvertent bursting out of hot metal but as an extra safety precaution electrical contacts closing during the last few thousandths of mold movement are employed to actuate a magnetic interlock which must be energized before the valve controlling the injection of molten metal can be operated. Mechanical interlocks of various designs also are in use.

When the die is filled, the momentum of the

hydraulic plungers and the body of molten metal is absorbed in a "wallop" which calls for a tremendous safety factor in the mold locks. Yet almost instantaneous mold opening and ejection must be effected in spite of the masses involved because only fractions of seconds exist between solidification and the ultimate shrink stress which results in casting fracture.

Mechanical die casting equipments are available, hand operated, semiautomatic or fully automatic, including core withdrawal. Successful equipments are built on the hydraulic principle, utilizing pressures of from one to three thousand pounds per square inch in conjunction with a storage or accumulator system which must be infallible at all times, both from the standpoint of maintaining line pressure and of avoiding lag which might prove disastrous.

A machine of the hydraulic type is shown in Fig. 5. One-half of the mold is attached to the bolster *A* by clamps and bolts set in the T-slots as shown. The other half of the die is attached by the same means to the movable die carriage *B* which is actuated hydraulically with the intervention of toggles *C*. These toggles not only make possible an adequate closing force with an hydraulic cylinder *D* of practical size, but they may be designed so that the moment resulting from the bursting force within the mold is negative, tending to hold them in the closing position.

Operating Sequence Given

Fig. 6 shows a metal handling means for alloys that may be melted in an iron pot. These include aluminum alloys. The goose neck fills through port *E*. It is advanced hydraulically until nipple *F* contacts with the gate in the die, and the metal is forced home by hydraulic actuation of plunger *G*. Melting pots may be gas or electrically heated.

The melting furnace may be portable so that it can be used at the side or end of the machine admitting metal at the mold joint (split gate) or through the body of the die (center gate) or in special cases at two or more points. Under shot machines also are commercially available.

A FEW hours spent on the design of a part to be die cast will save a formidable cumulative loss of time in production. Harold F. Shepherd, author of previous articles in this series, and W. J. During, Chief Engineer, Precision Die Casting Co., have collaborated in the preparation of this timely contribution on designing for production by die casting.

For brass and bronze a charge of metal previously melted in a crucible or an electric furnace is poured into a cylinder, and by rapid manipulation of an hydraulic plunger forced into the mold before it can freeze.

Custom die casters sometimes state that the economies of the system are not available unless 10,000 or more castings are required. Die casting machine makers on the other hand, advise owning machines and making lots of the number required for immediate use to avoid large inventories. Some compromise between these extremes may develop in individual cases. However, since mold cost is a large item the designer of the product may do much to make small lots advantageous by making parts as simple as possible.

Engineers Are Progressing

Molds for white metal may be considered permanent for many requirements. Aluminum at high temperature and pressure tends to erode dies by direct "placer" action or by alloying as

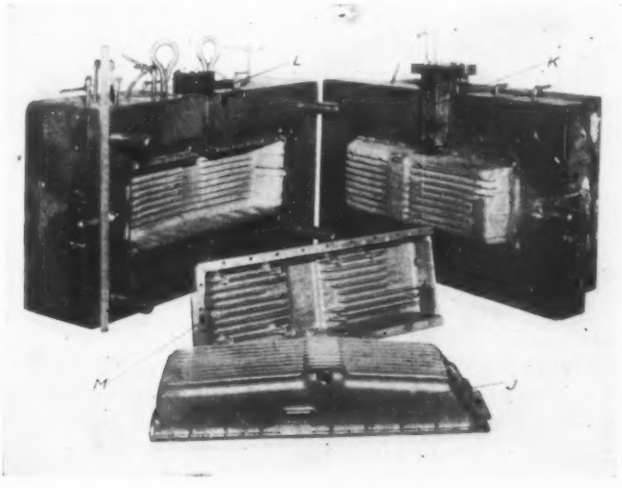


Fig. 7—Prompt mold opening and automatic ejection assist in combating shrinkage

in calorizing and sherardizing. The engineers of the industry aided by metallurgists are making progress in limiting these actions.

The accuracy and finish available with die castings is an outstanding attribute, especially for machines in which good appearance is an asset. If the chief machine designer will offer fullest collaboration in the way of redesign to suit the process, at least until general draftsmen grasp its fundamentals, marvelous progress should be possible in this industry.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Die Castings Reduce Machining," by C. R. Maxon, March, 1931, p. 42.

"Metal Processes Show Progress," Feb., 1932, p. 23.

"Simplifying Parts Production by Die Casting," by Louis H. Morin, Nov., 1932, p. 32.

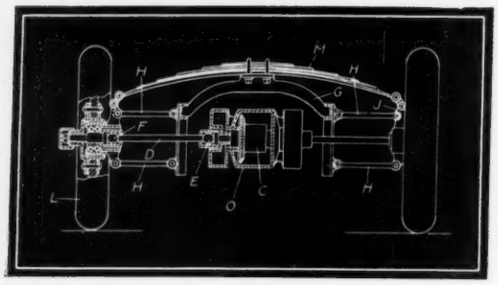


Fig. 1 — Universal joints permit extension, contraction of drive shafts due to movement of parallelogram frames

Rear Engine Shows Promise

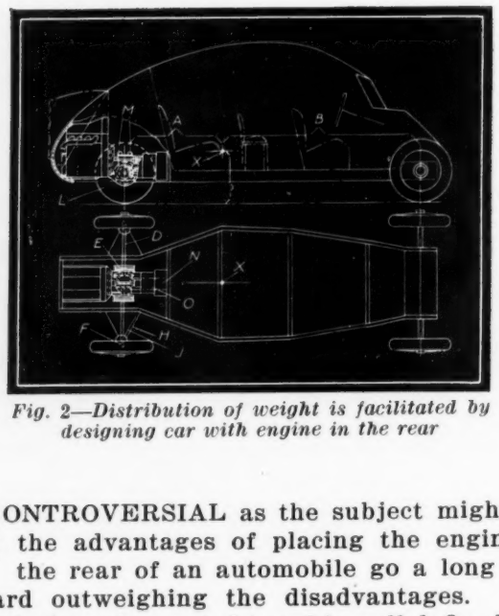


Fig. 2—Distribution of weight is facilitated by designing car with engine in the rear

CONTROVERSIAL as the subject might be, the advantages of placing the engine in the rear of an automobile go a long way toward outweighing the disadvantages. Although the rejuvenated trend is well defined and already has been adopted by some manufacturers abroad, automotive engineers in the United States have been more conservative, adhering to orthodox design. Experimental models, however, have been built in this country.

One of the prominent automotive engineers championing the cause of the rear engine car is Charles Denniston Burney, Westminster, England. So confident is he that the car of the future will be built along these lines that he has protected his designs by patents both in Great Britain and here. Figs. 1 and 2 depict one of his most recent creations.

It is an incontrovertible fact, Mr. Burney declares, that in motor road vehicles the weight distribution governs the efficiency of springing, affects pitching during braking or acceleration, and largely governs the skidding propensities of the car while turning or braking. In the car of conventional design the position of the center of gravity usually is midway between the front and rear wheel positions, so that under static loading the load is nearly equal on each of the four wheels.

According to the theory underlying Mr. Burney's machine the center of gravity should be so located that the weight distribution will be substantially equal on all four wheels under emergency conditions where the brakes are applied with maximum pressure with the vehicle traveling at high speed and perhaps on a slippery road. Consequently maximum adhesion of the wheels is obtained when most needed.

On a modern car having powerful brakes a deceleration in excess of 24 feet per second is possible, but with the result that during the period the adhesion load on the rear wheels is reduced to approximately one-third of the weight of the car. To correct this condition, therefore, Mr. Burney in his invention contemplates a weight distribution so that the position of the center of gravity under static conditions is situated at a point approximately one-third of the length of the wheel base in front of the rear axle. Consequently the resultant load on all wheels will be equal under conditions of maximum deceleration. Such a weight distribution, he asserts, can be had only with rear engines.

Principle Embodies Equation

If A and B are the distances of the center of percussion and center of rotation respectively, from the center of gravity, and assuming K to be the radius of gyration of the body, then A and B are connected by the relation $AB/K^2=1$. Mr. Burney has seen that in the principle of his invention, Fig. 2, this equation holds good, A and B being the distances of the rear and front axles from the center of gravity and K the radius of gyration about the center of gravity, so that

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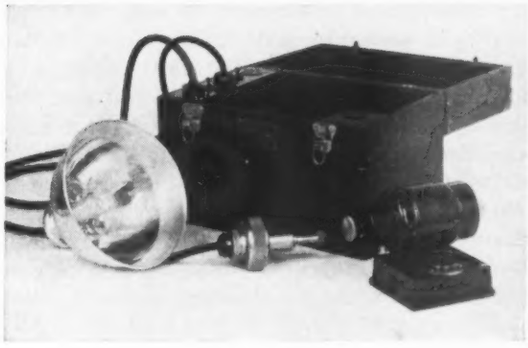


Fig. 1—Periodic flashes of neon light illuminate machine being examined by the stroboscope

"Slow Motion" May Disprove Calculations

By J. H. Pound

INCREASES in speed of modern machinery have necessitated continual development of instruments designed to show the behavior of objects moving too rapidly for observation by the human eye. At high rates of speed, inertia, friction, elasticity of materials, centrifugal forces, etc., sometimes have unsuspected results. Even when the design is correct, variations in materials or workmanship can produce undesirable effects. What actually happens in the operation of a mechanism is often quite different from what is expected in theories developed in the design.

To detect the causes of these faults devices like the balancing machine, the oscillograph, the motion picture camera and the several forms of stroboscope are finding increasing application in mechanical research, in machine design, and in tests of finished machines.

NOTHING can be more exasperating to the careful designer than a machine designed and built on fundamentally sound and proved principles that does not operate correctly. Often the cause of mal-operation cannot be determined by analyzing the stationary machine. Now it is possible to find the weaknesses and correct them as outlined by J. H. Pound, Rice Institute.

Balancing machines, the chief use of which is in giving final adjustments to a manufactured article, will not be discussed at this time. The other devices mentioned, however, have wide uses in research and in development of many kinds of machinery while some of them recently have experienced important improvements. Their field lies principally in the study of periodic motion rather than in intermittent motion.

For many years certain well known, high speed instruments have avoided inertia and friction difficulties through the use of light or the employment of electromagnetic effects. Well known examples are the optical gas engine indicator, the piston of which moves a beam of light, and the cradle type of electric transmission dynamometer, in which measurement of the pull due to magnetic reaction between a generator's rotor and its stator, supported in ball bearings, allows the accurate and economical measurements of power at high speeds and in large amounts. It is not surprising, therefore, to find such weightless mediums as light, magnetism and electricity used in a number of less familiar high speed testing instruments.

One of these is the oscillograph, an electromagnetic instrument with possible applications in the mechanical field which are not so well known as its wide utility in strictly electrical

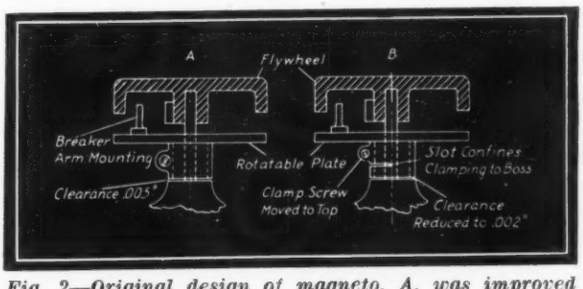


Fig. 2—Original design of magneto, A, was improved to B after stroboscopic examination

investigations. Reduced to its essentials, it is simply a delicate galvanometer with a mirror which reflects a spot of light upon a moving photographic film or a ground glass screen. Any mechanical effect which produces a change in the electricity flowing in the coil of the galvanometer causes movements of the mirror which can be recorded on the film. This mechanical effect often is detected by causing it to alter the magnetic field surrounding a coil connected to the oscillograph circuit.

Turbine Disks Investigated

An interesting use of this type of apparatus appeared in an investigation of the bending of rotating turbine disks conducted by General Electric Co. some years ago. A stationary coil mounted inside the turbine casing was found by the oscillograph to carry a pulsating current, caused by the rotating steel disk bending out toward the coil at regular intervals. The number of bends in the disk at any speed was determined easily from the standard frequency curve and the known speed of the disk. By

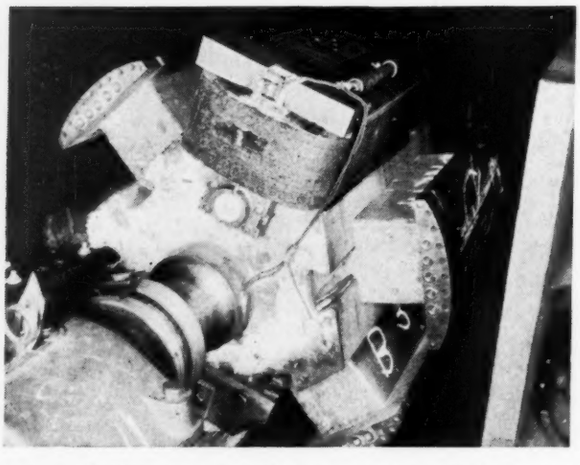


Fig. 3—Instruments attached to moving machines may be read and displacements determined

mounting a second coil on a radial arm which rotated with the disk and near it, the fact was established that these bends were sometimes stationary with respect to the casing and sometimes traveled forward or backward with respect to the casing. The data resulting from this investigation produced economies in the manufacture of disks known to be safe before they left the shop.

The motion picture camera and the stroboscope both secure their data by optical methods of considerable similarity. They literally translate high speed motion into stationary images, or extremely slow motion, permitting detailed study of co-operating parts while they are in action. The camera has the advantage of producing a permanent record, but the ordinary stroboscope often is a more flexible and more adaptable equipment, suited to a large variety of speeds and surroundings. With both instruments, two systems of securing data may be used: The object may be illuminated steadily and a properly timed and rapidly operated shutter may be used to register a series of stationary images on moving film or on the human eye; or, the shutter may be dispensed with and the object illuminated by rapid flashes, the frequency of which can be varied.

Mechanical stroboscopes use some sort of mechanically operated shutter, and all of them depend on persistence of vision, as does the projected motion picture. Mechanical models are

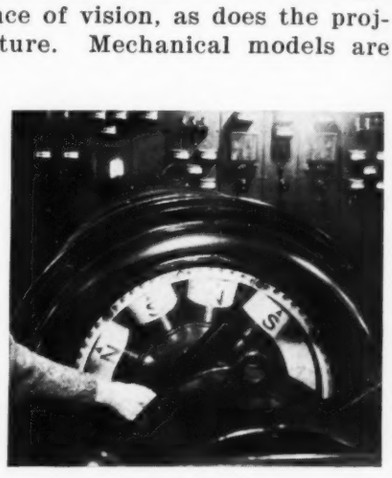


Fig. 4 — Unretouched photograph taken during examination with a stroboscope showing armature at speed of 1200 R.P.M. with poles painted for north and south polarity

limited in that observation must be by a single observer. Persistence of vision will result with ten or more glimpses per second. The earlier designs of stroboscope used as shutters radial slots cut in large diameter disks, which were limited in speed by mechanical stresses. This trouble was diminished by substituting either small diameter high speed cylinders slotted parallel to the axis or else concentric rotating cylinders similarly slotted. In one commercial stroboscope the shutter is driven by a spring and clockwork through a governor and a change gear box. This arrangement allows a frequency of glimpses between 100 and 40,000 per minute.

Speed Changes Are Possible

Small changes in shutter speed are possible through governor adjustment, thus allowing the formation of creeping images if desired. By adjusting the instruments to give a stationary image and then reading the glimpses per minute from its scales, one can learn the rotary speed of machinery too delicate or too inaccessible to allow the attachment of a tachometer direct. Shutters driven by electric motor are practical and may be desirable for long continued examination but they make the instrument more complex and less portable, the latter characteristic being an important advantage.

Optical stroboscopes use no shutter but illuminate the object by periodic flashes of light. Early instruments utilized either a rotating many sided mirror or an electric arc. The mirror method has been used in Japan in securing photographs at the remarkable rate of 20,000 pictures per second, the mirror being a 120-sided rotating steel disk. The arc lamp method is slower but is more easily provided. The optical instruments are especially advantageous in that several observers can study the moving parts at one time.

A more recent and more convenient method of illumination was developed after the invention of neon tubes. Several equipments now on the market produce light flashes from neon hand-lamps supplied from portable batteries, Fig. 1. The timing of the flash commonly is secured mechanically from the machine being examined by pressing a rotary circuit breaker against the end of rotating shaft of the machine much as when reading speed from a hand tachometer.

Stationary Image Possible

This direct drive gives a stationary image of the machine, but by driving the breaker through a gear train which makes the breaks come a little slower or faster than the cycles being observed, a creeping image will result. By manually shifting the yoke carrying the breaker points while holding the housing of the breaker steady, the light flashes can be adjusted to give a stationary image at any point in the cycle, much as the timing of a magneto spark can be shifted to suit the needs of an automobile engine. Stationary images permit reading of instruments which are attached to and rotate with the speeding machine, Fig. 3.

The breaker also can be driven independent of the tested machine through the provision of a small electric motor and an adjustable governor. By measuring the motor speed with a tachometer when the lamp flashes show a stationary image, the apparatus serves indirectly as a tachometer. Adjusting the motor speed to be slightly more or less than that of the machine tested gives a slowly moving image.

Breaker speeds of 12,000 revolutions per minute are said to be possible. One should note, however, that except for speed measurement purposes the glimpses per minute required by any stroboscope to produce a stationary image need not equal the cycles per minute of the object. Often one-half or one-quarter that many glimpses per minute will serve to give a stationary image, thus allowing the stroboscope to operate much slower than the machine being tested.

Investigation by stroboscopes has improved the mechanical design of textile, sewing and bag-making machinery, vacuum cleaners, chain drives and the like. Another practical use has been in checking the rotary speed of sensitive gyroscopes. Useful information has been obtained on such problems as the shimmy of automobile valve springs, the behavior of lubricating oil supplied to rapidly moving gears, exact adjustment of motion and sound picture machinery, cam action, meshing of gears, etc.

Stroboscope Reveals Fault

A manufacturer of magnetos discovered that machines on which his parts were used were getting especially poor sparking from a flywheel magneto at low speeds. The electrical side of the job was checked up and found to be all right, and no mechanical defect could be seen. The breaker mechanism was examined with a stroboscope and the trouble became apparent immediately. The breaker cam was mounted on the flywheel and the breaker arm was carried on a plate, Fig. 2*A*, the latter being rotatable on a boss projecting from the engine crankcase for the purpose of advancing and retarding the spark. It was found that due to a slight tipping of this rotatable plate the pad on the breaker arm was hitting the corner of the cam, thus causing a misalignment of the breaker points. This could not be seen when the cam was stationary because there was enough spring in the breaker arm to cause it to conform with the flat surface of the cam. This trouble was cured as shown in Fig. 2*B*.

Fig. 5—Lettering on a two-foot disc whirling at 2000 R.P.M. can be read easily

Stroboscopes also were used by the same company with the result that a suspected cause of trouble was found to be perfectly clear, while an unexpected source caused the difficulty. It was found that sparking was poor above 3400 revolutions per minute with a new type of six-cylinder magneto. It had been considered that this

trouble was due to the speed being too high for the breaker arm to follow, until some of these magnetos were run on a mechanical test at a little over 4000 R. P. M. Careful checking of the breaker mechanism, using a microscope in conjunction with a stroboscope, failed to show up any fault in the operation. The search for the trouble was turned in another direction and it was found that the difficulty was not mechanical at all, but had been caused by too high an impedence in the armature, a condition corrected by changing the winding.

Sometimes photographs of rapid movements are desired. They are difficult to secure where a shutter stroboscope is used, but with a neon flash lamp showing a stationary image in a darkened room a long exposure or panchromatic negatives will yield good results, Fig. 4. Much better ones would be expected from the quality of light emitted by a mercury arc flash lamp and especially for high speed photography of non-cyclic movements this device is valuable. With it, good photographs have been secured with exposures of less than 0.000,01 seconds. Timing of the flashes can be controlled mechanically by

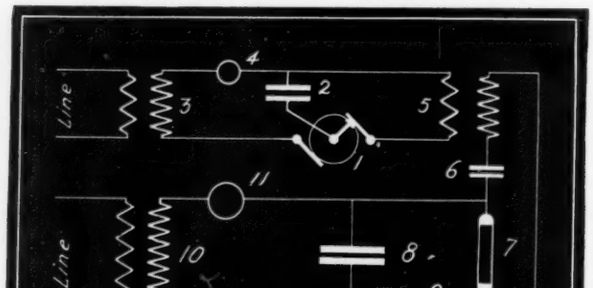


Fig. 6—Chart of electrical devices employed in design of optical stroboscope using neon tubes

In operation a rotary synchronizer 1 alternately produces charges of a low capacity condenser 2 from the current of transformer 3, then discharge of condenser 2 into primary windings of the high frequency transformer 5. This induces a discharge from the secondary of transformer 5 through condenser 6 and neon tube 7. Lighting current, stored in condenser 8, has to jump across spark gap 9 to pass through the tube. When the controlled passage of priming current occurs in the tube, system resistance is lowered and current from condenser 8 jumps the spark gap and discharges as a light flash through the neon tube. Condenser 8 is kept charged by rectified current from lighting transformer 10.

a simple breaker, but a superior electrical method substitutes a thyratron relay, resistances and condensers for the mechanical breaker. This electrical circuit avoids all moving parts while allowing control of flash frequency. It permits stroboscopic examination of cyclic movements, high speed photography of ordinary machines, and even photographs of objects, such as projectiles, to which no ordinary connection is possible. Pictures have been secured by this method on a drum of film through a shutterless camera at a rate of 4200 pictures a second. This probably is the most recent development in high speed photography.

One of the first instances of securing increased efficiency in machine design by means of motion pictures, had to do with a high speed addressograph machine which jammed in the envelope in-feed. A micromotion outfit was arranged to take a close-up of the feeding mechanism with the feeding pawl painted white to facilitate following its motion. Motion pictures, taken at 4000 frames per second, disclosed that the feeding pawl vibrated at one time and not at another. Each time the pawl vibrated it failed

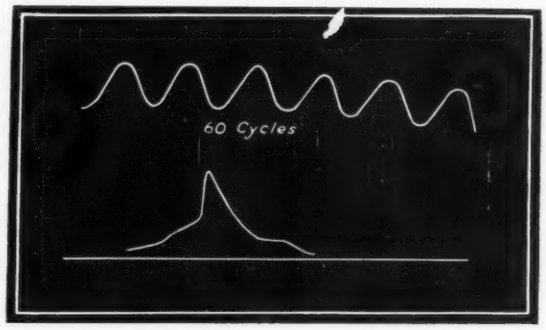


Fig. 7—Mechanical effects can be arranged to be recorded on a film with the oscillograph

to feed an envelope. Not only did the pictures show this effect but they registered the time, by means of a high speed stop watch, so that at least a reasonable approximation of the duration of the oscillation could be obtained. With this information the designers were able to effect improvements immediately.

Attention Is Centered

There is one peculiar advantage that a designer gains by taking pictures of a machine which is not apparent at first sight. The motion picture camera is trained on just the essential field of action and is viewed in a more or less darkened room free from distraction. As a result, the attention is centered on the screen and one is not subjected to the many distractions of sight or sound which are a necessary concomitant to the actual machine. It is not always necessary to take slow motion pictures to get results.

With such improved controls, engineers seem in a fair way to surmount the obstacles of inertia and similar mechanical troubles so common in high speed instruments.

Appreciation is accorded the following companies for their assistance in furnishing illustrations and specific examples of applications in design for this article: Bell & Howell Co., Electrocon Corp, Stroboscope Corp., General Radio Co., Westinghouse Electric & Mfg. Co.

Gear Technology Is Discussed

WHETHER it be a horsepower formula for large gears, design of motorized speed reducers, features of welded steel gearing or a discussion on the cyanide process of hardening, industry and particularly the designer are concerned. These and other topics are treated in this article.

ACTIVITIES of the American Gear Manufacturers association at its recent annual meeting in Wilkinsburg, Pa., characterized the endless pursuit of technology to provide designers of machinery with quality gears. And not only was the technical aspect of various types studied but considerable discussion was devoted to the commercial side of the industry. Much better sentiment was observed among the various manufacturers and indications were that orders in more encouraging volume are being received.

Among the technical papers presented was a discourse on the design and manufacture of large gears for industrial service. Thomas Holloway, United Engineering & Foundry Co., Pittsburgh, the author, ably handled his subject. The number of installations of large gears of high accuracy are fairly limited, he said, citing for instance continuous strip mills which now are operated at speeds as high as 1300 feet per minute. Finishing end of a hot strip mill will take from 3500 to 5000 horsepower motors on each stand, and it is quite common for the gears to reach a velocity of over 3000 feet per minute with tooth pressures as high as 2000 pounds per inch of face, neglecting overloads.

One difficulty with which every designer of large gears must cope is the lack of a horsepower formula which will include all of the various factors involving the life of gears. There are a number of different formulas published which supposedly determine the load carrying capacity of gears but all the large gears manufacturers temper these formulas with experience. There is for instance a wide variation in the types and quality of materials employed, and considerable difference in service conditions.

A few years ago it would have been necessary to modify further still the average load figure with a factor for mounting and installation, to allow as far as possible for various inaccuracies of cutting and inadequate lubrication. It reasonably may be assumed, however, that new gears up to ¾ pitch are properly mounted, reasonably well cut and well lubricated, since these points have been given considerable attention by engineers throughout the industry, so that modifying factors may be confined to: A service factor; a material factor, and a velocity factor. We then have a guide for the determination of horsepower.

Traces Gear Motor Development

Combined motor and speed reducer units furnish a solution to a better means for mechanical transmission of power where speed reduction is a primary factor, said R. S. Marthens, Westinghouse engineer. By extremely interesting illustrations he traced the development of gear motors from the beginning and pointed out many of the problems which have confronted engineers engaged in this work. Gear manufacturers, he continued, should appreciate fully that the gear motor is a gearing development and not a motor development.

Outlining questions to be settled in connection with the design of these units, he referred to the material which should be used in the gears and pinions. Most manufacturers have employed all steel gearing, either of plain carbon steel heat treated or alloy steel.

Another point he brought out related to pre-

ferred series numbers. One of the problems that must be dealt with in designing gear motors is to determine the number of ratios which will be listed in the catalog and presumably carried in stock by the manufacturer. It is highly desirable to use a preferred series as this enables the manufacturer to list uniform percentage steps in output speeds and enables customers to choose from the catalog a standard speed which is close to the speed calculated for the output shaft. The preferred series of numbers is receiving more and more consideration on the part of machine designers and he recommended that gear motor manufacturers take advantage of the opportunity and adopt this method of listing available ratios. Such a series has not been used in the past in listing ratios for speed reducers, but has been considered only from the number of teeth. It has been found in designing a line of gear motors that the number of teeth can be so ararnged that a preferred series of ratios can be secured readily.

Cyanide Process Is Popular

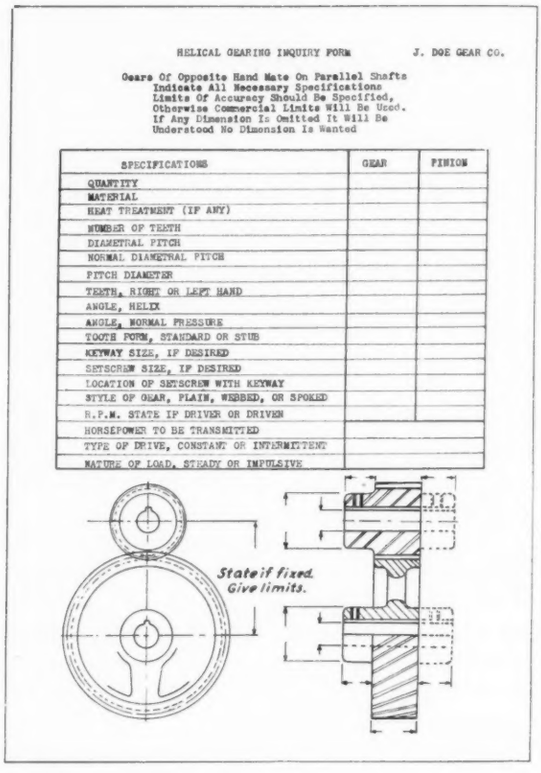
The cyanide process of hardening is at present popular not only because of the method itself but because of the useful properties imparted to the surface of the gear, E. F. Davis, Warner Gear Co., Muncie, Ind., pointed out in his address on heat treatment of gearing.

"A myth I would like to explode," said Mr. Davis," is that the process of cyaniding makes noisy gears. Bad tooth form is the chief cause of this condition. It often has been assumed that cyanided gears have a higher pitched tone but after observing one transmission model in production for three years with rejections not over 1 per cent I see no basis for the assumption that the operation of cyaniding has any influence on the acoustics of transmission gearing."

Features of the welded steel gear run hand in hand with a design freedom that permits different carbon or alloy content in different members of the gear, asserted Everett Chapman, Lukenweld Inc., Coatesville, Pa. This type of gearing is extremely quiet running, to a great extent due to the fact that the circular area of the thin web can be broken up by U-shaped spokes into a series of triangular areas. It is well known that a circular unsupported area gives a drum head effect due to its symmetrical vibration characteristics and relatively high degree of freedom. In progresing from the circle to the square to the rectangle and to the triangle, the susceptibility to free vibration becomes less and less. This has been borne out in many actual applications of this construction.

In outlining the record of this type of gearing he explained that there have been only two cases of vibration troubles reported in a total of 800 units. Both of these cases were traced to the presence of a gear with cast teeth in the gear train in which the welded gears were running. At certain speeds an exciting frequency was picked up by the welded gear and the resulting resonance was disturbing. A remedy was effected by cutting a slightly larger hole in the web, merely changing the natural frequency of the welded gear to a point where it was not in resonance with the exciting frequency.

Standardized specification or inquiry sheets to be used in obtaining cost and other information from gear manufacturers were accepted as recommended practice, having been prepared and submitted by the library committee under the chairmanship of M. T. Schumb, Boston Gear



HELICAL GEARING INQUIRY FORM J. DOE GEAR CO.

Gears Of Opposite Hand Mate On Parallel Shafts
Indicate All Necessary Specifications
Limits Of Accuracy Should Be Specified,
Otherwise Commercial Limits Will Be Used.
If Any Dimension Is Omitted It Will Be
Understood No Dimension Is Wanted

SPECIFICATIONS	GEAR	PINION
QUANTITY		
MATERIAL		
HEAT TREATMENT (IF ANY)		
NUMBER OF TEETH		
DIAMETRAL PITCH		
NORMAL DIAMETRAL PITCH		
PITCH DIAMETER		
TEETH, RIGHT OR LEFT HAND		
ANGLE, HELIX		
ANGLE, NORMAL PRESSURE		
TOOTH FORM, STANDARD OR STUB		
KEYWAY SIZE, IF DESIRED		
SETSCREW SIZE, IF DESIRED		
LOCATION OF SETSCREW WITH KEYWAY		
STYLE OF GEAR, PLAIN, WEBBED, OR SPOKED		
R.P.M. STATE IF DRIVER OR DRIVEN		
HORSEPOWER TO BE TRANSMITTED		
TYPE OF DRIVE, CONSTANT OR INTERMITTENT		
NATURE OF LOAD, STEADY OR IMPULSIVE		

Standardized form adopted as recommended practice

Works, Quincy, Mass. The following explanation accompanied the six sheets of which the illustration herewith on helical gearing is typical: "As gear manufacturers, we find a lack of understanding by many gear users as to the information required by the manufacturer either to quote or make gears the way they desire them. To make it easier for the customer to express his wants and to enable us as manufacturers to quote intelligently or to make gears exactly the way they are desired, and at the same time not add unnecessary operations in the manufacture of the gears that would make them more costly, we append a set of sample specification sheets which show all the dimensions that are required by a gear manufacturer and many, if not all, by the user."

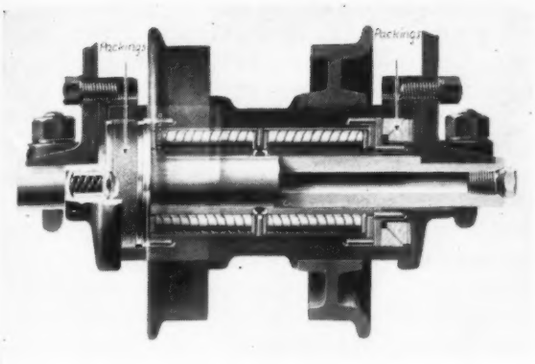


Fig. 1—Truck wheel assembly employs beveled ring type of cork seal

Careful Design Prolongs Packing Life

By Allen F. Clark
Associate Editor, Machine Design

SINCE the cost of replacing a packing is frequently ten to twenty-five times as great as the cost of the packing itself, it is obvious that the engineer who designs his packing installation correctly is performing a real service for the user of his machine. Furthermore, a direct economic loss occurs whenever any lubricant escapes from a bearing. Insignificant as this loss may be for any one bearing, the potential losses, while not immediately apparent, may be serious. Lost lubricant may interfere seriously with the function of a machine and thus reflect on the ability of the manufacturer.

It may be stated that there is no universal seal which will meet all conditions of service successfully and at the same time avoid undue complications and expense. For best results, it is advisable to take up the packing problem carefully, considering the available materials, consulting the manufacturers, and selecting the material and type that best suits the specialized requirements of the particular application. No two installations are exactly alike, and the wide range of packings available make it impossible to lay down general rules for all applications.

In addition to the unit type of seal discussed in the Aug., 1932, issue, separate sealing materials commonly found on the market are leather, felt, cork, cotton, asbestos, flax and rubver, with innumerable grades and combinations of each available. For example, cork may be ground into small particles and recombined with various binders producing a composition material. The character of this binder can be varied infinitely to combat the conditions encountered. An additional attribute which fits the materials to the exact needs of the designer is that they can be molded or cut to any shape desired.

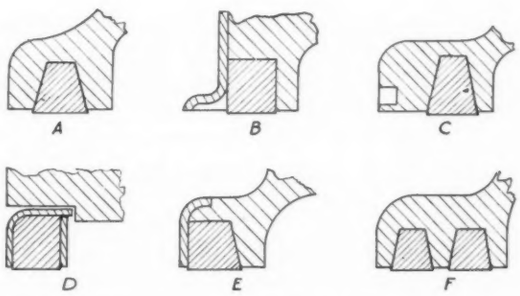


Fig. 2—Felt seals should fit into grooves which are isosceles trapezoids in cross section

ASBESTOS. This material is especially resistant to most acids. There is a wide variation, however in the acid resisting qualities of different types or kinds of asbestos fiber. The commonly used white asbestos fiber is entirely satisfactory as a packing material against some acid conditions. On other conditions, however, the acid attacks and quickly destroys ordinary white asbestos. Blue Cape asbestos yarn has been found to be practically impervious to the action of mineral acids at room temperatures, although it is attacked to a greater or lesser degree by such acids at boiling temperatures.

FELT. Lubricant is held around the fibers of felt, the material becoming a reservoir. Flexible in performance as a felt seal may be, however, the observance of certain precautions is essential. The parts should be generous in size, a condition the importance of which cannot be overemphasized. The ring should be a snug fit on

the journal, that is, the hole originally should be several thousandths smaller than the journal, for diameters of ½ to 4 inches. Tighter fitting rings cause heating. The groove in which felt rings are located should be machined and the channel should be an isosceles trapezoid in cross section with the walls tapering four degrees toward the outer diameter of the washer on each side, Fig. 2*A*.

In the case of detachable glands where one

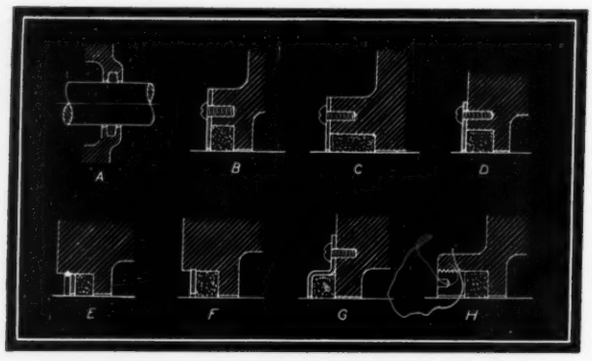


Fig. 3—Recommended and unsatisfactory installations of cork depend on grooves and fastening method

side must be perpendicular, the opposite wall of the channel should taper back at an angle of 8 degrees, Fig. 2*E*. This channel causes a pinching of the ring at the outer diameter causing the fit to exert its pressure constantly toward the journal. It is a mistake to chamfer the faces of a washer to fit such a channel. The washer is left with full thickness over its full area.

Leather Seals Efficiently

LEATHER. An efficient sealing material and one of the most widely used packings at the present time is leather. However, acids and alkalies are great detriments to leather and even with the use of mineral tanned or chrome tanned leather, it is almost impossible to make a seal of this material that will withstand acids, alkalies and other such fluids. For applications where the seal is exposed to water, specially treated leather is available. Leather resists mineral oil.

CORK. Exceptional resistance to the penetration of liquids is provided by cork and the material is widely used as a seal, Fig. 1. Except for a few highly corrosive chemicals, no liquids can work their way through its structure to any marked degree. Acids are resisted when they are in weak solution, but the material cannot be used in contact with alkalies. No deterioration is produced by gasoline and the material is oil proof with mineral oils, a property not affected at elevated temperatures. Although it is necessary to fabricate the cork parts to closer working tolerances than is usual for other types of seals, this slight disadvantage is overcome by its sealing powers. Its limitation in this service is its comparatively low tensile strength, prohibiting its use in certain types of bearing designs.

It is inadvisable to use cork as a sealing material where the packing must be assembled into an internal groove, Fig. 3*A;* where sustained temperatures are in excess of 200 degrees Fahr., as long continued heat chars the cork.

Frequently no change in design is necessary for the adoption of cork. If a change seems desirable, however, it should be made in accordance with the following recommendations:

The grooves must be straight sided.

In general a ring of approximately square cross section is preferable to one having a long contact surface but a thin wall, Fig. 3 *B* and *C*.

The ring should be compressed slightly from the sides to eliminate any tendency to turn with the shaft. The amount of "squeezing" may vary from 1/32 to 1/16 inch depending on the size of the ring and the density of the material employed.

The seal may be retained by the use of an end cover, or washer of standard design such as those shown in Fig. 3, *D* to *G*.

Use of a threaded member as shown in Fig. 3*H* is not recommended because of the twisting strain it exerts upon the cork.

CUP TYPE. An important application of packing, differing in function to the usual type of packing outlined in the foregoing is those seals

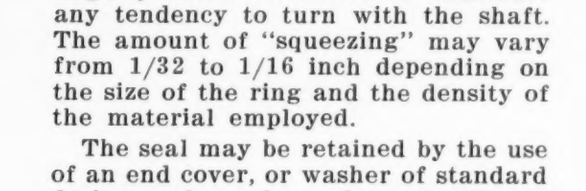


Fig. 4—Definite limitations govern design of co-operating parts using leather cup packings

used to hold pressure in hydraulically or pneumatically operated equipment such as presses, pumps, etc. The principles of the proper design and installation of such packings are entirely different from the ordinary forms. Among the types of packing in common use for this service, the cup and U types are the most frequently incorrectly installed. There are three fundamental elements to any cup packing installation as illustrated in Fig. 4. *A* is the back follower plate which may be a plate or a head of a piston

(*Concluded on Page* 39)

Haphazard Thinking Rarely Succeeds

By George M. Eaton

RECENTLY American engineering training was criticized because of the absence of a definite plan to inculcate in the mind of the engineer the habit of independent thought. Our training was defined as a memory-stuffing process, and it was stated that our curricula are so loaded with fact data that there is no time to think, let alone time to learn how to think.

To the layman, the task of teaching independent thinking appears extremely difficult. If the teacher is an independent thinker and is able to impress his own habit of thought on his audience they may profit greatly, but there is some question about their independence. They may, however, from this start eventually evolve a state of independence.

In an effort to reach this goal, which has extended over a good many years and which is still in progress, the author has worked out a rather definite procedure for his own guidance.

No rules for thought will be equally constructive for all types of mind. Therefore, the system here presented is not prescribed as a cure-all. It has, however, proved helpful to some engineers.

The system is a method of written analysis in which an orderly procedure is assured by following the steps provided in the form shown in the accompanying table. It was designed specifically for use in the development of new machines, but it has proved to be applicable, in general principle, to any situation where it is necessary to gather and analyze fact data and reach a decision leading to action.

In behalf of the cause of independence, it is urged that any one who chances to decide to adopt a definite thinking machine avoid the use of this particular machine as it stands. He should build his own machine.

THINKING is one of the most difficult of human processes to guide and control. Yet some guidance is vitally necessary as a disorganized mind will produce only disorganized results. In this article, reprinted from the May "Mechanical Engineering", Mr. Eaton, director of research, Spang-Chalfont & Co. Inc., gives an admirable plan for constructive thought.

Master Form Changes

The master form, such as that shown in the table, is in a state of constant flux, and is modified almost every time that it is reviewed critically. Otherwise thinking ceases to be independent.

Item 1 is hard to obey but it is of fundamental importance. At the start of the attack on a new problem the mind must be focussed solely on the completeness and accuracy of the specifiation.

Item 2 brings out a clearer definition of the problem than any of the other classifications with which the author experimented. The positive and negative features often are only differently worded repetitions of each other. But it has been found that the use of both the positive and negative points of view sometimes brings to light an important consideration which otherwise might be overlooked. These four categories of factors form the complete foundation for the subsequent analysis, and they must be impregnable. In important situations it is wise to return to them repeatedly in a savage attempt to break them down.

Item 3 is avisable because it is always possible that a clear understanding of the problem should carry with it the recognition that the original belief in the justification of the attack was incorrect. At the time of the recent

addition of the sub-items on employment and social effect, the benefit of their inclusion looked doubtful. But the very fact of having them continually in evidence has borne fruit in a small way.

Item 4 is in direct contradiction to the procedure followed by many. There are definite advantages that may be cited in favor of a thorough review of everything that others have done before launching one's own attack. But it has been the author's experience that there is too much danger of following the lead of others and missing some vital possibility when one's attack is other than entirely independent. The review of the literature should be made after the completion of one's own analysis.

Written Analysis of a Specific Problem

1 ..... Close the mind resolutely to all thought of solution till 2 and 3 are completed

2 Define problem .....
- Ideals; must be satisfied ..... No compromise
- Desirables ..... Can compromise
- Undesirables ..... Can compromise
- Intolerables ..... No compromise

→ Consult with those acquainted with problem, but reserve right to doubt

3 Assuming problem solved...
- Is demand now urgent? .....
- Can market be developed? .....
- Effect on employment .....
- Economic and social effect .....
- Steps for social protection .....

→ Is attack on problem justified?
Decision ..... Go ahead; state reason / Quit; state reason

4 Lines of attack.....
- Past experience ..... Of self / Of others ..... Acquaintances ..... / Literature ..... → Avoid till all other avenues have been followed to bitter end
- Applied Science ..... List possibilities
- Pure Science ..... List possibilities
- New Research ..... List possibilities

5 Tentative solutions .....
- Written description and sketch of every scheme
- Include every scheme, regardless of practicability

6 Eliminative analysis .....
- Vertical list of schemes
- Horizontal list of determining items
- Evaluate each scheme under each determining item
- Indicate absolutely condemning features, discarding schemes affected
- Indicate bad but less serious features, discarding in order of undesirability
- Select least undesirable scheme (*Never try to select best scheme*)
- Weigh selected scheme against item 2
- Try to prove selected scheme inadequate

7 Decision ..... Go ahead / Search for better solution

Uncovering Novel Features

Item 5 covers the phase of detailed scheming. Sometimes a scheme that appears to be quite foolish when considered in toto has one novel feature that can be incorporated in a practical development.

Item 6 is perhaps the key-note of the whole system. It is difficult for the inventive mind to wrench itself away from the bubbling enthusiasm generated by the birth of a new idea. Almost inevitably some pet scheme stands out among the candidates for selection. The beauties of this scheme overshadow its deficiencies in the "fond parent" mind of the inventor. For this reason it has been found absolutely necessary to proceed on the negative side, throwing out the worst schemes successively. If the eliminative analysis is laid out with the set purpose of proving the superiority of some pet scheme, then the analysis is a waste of time. Absolute honesty is a prime essential and unless one can go through the work coldly, letting the chips fall where they will, he is not capable of conducting any real analysis.

In filling out each space in the tabulation, the mind must be closed to everything in the world except the truth and fairness of each specific evolution by itself. When this course is followed through with patient honesty, the selection of the least undesirable scheme is assured if sufficient essential facts are known. The written tabulation then forms a permanent record of the course which it has been decided to follow and of the reasons for that decision.

It is not germane to go further into the details of this system. Each step is divided into major classifications which then are broken down to the closest possible approximation of fundamental details, the general form of scheduling being similar to the master form.

Some men are so fortunate that they can go through the operations of analysis mentally without the burden of writing, but there are a great many more who only think that they can do this. We admire and envy the gifted individuals whose minds cut through quickly and reliably to the logical solution. But we find it essential to reduce analyses of important issues to writing, and in an orderly manner.

The criticism of engineering training referred to in this article is "Educational Preparation for Creative Technical Engineering Leadership," by R. E. Doherty, *Mechanical Engineering*, Feb., 1933, p. 90.

Specify Steel Exactly!

By H. G. Marsh

IN SUBMITTING inquiries to the steel manufacturer for material for welded construction it is of utmost importance that sufficient information be given. Surface requirements, flatness, size tolerances and quality all enter into the question of price, and the more that is known about these things the more intelligently the inquiry can be handled. Otherwise the manufacturer, according to Mr. Marsh, Carnegie Steel Co., in a paper presented before the American Iron and Steel institute, might quote on a highly finished plate, rolled closely to size and carefully flattened, for a part that is to be machined all over and which easily could be made from a billet or slab at a much lower price.

While there is a great variety of material available, the designer will do well to confine himself to the fewest number of shapes and sizes, as some of the published shapes are not always quickly available. The fewest number of shapes and sizes should serve the greatest number of uses.

A most important thing for the designer when first taking up welded construction is to clear his mind of the restrictions imposed upon design by previous methods of fabrication as it is desirable if the best results are to be obtained to take full advantage of the qualities of rolled steel. The best way is to start anew with a careful analysis of the function of the machine and its component parts. The direction and magnitude of the stresses involved should be calculated as closely as possible, their relation to each other studied, and then the best adapted rolled steel sections should be selected and combined in the simplest possible way.

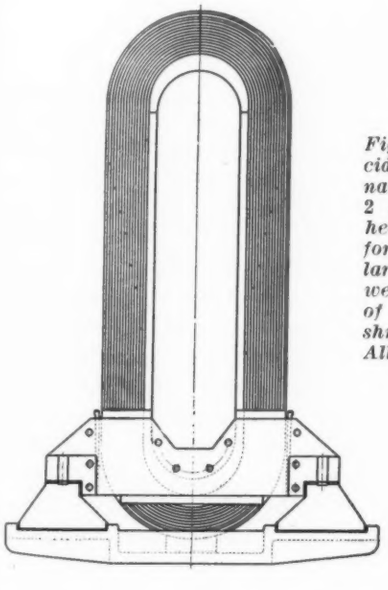


Fig. 1—Design finally decided upon after preliminary steps shown in Fig. 2 consists of a core of heavy rolled steel slabs for sides with semicircular ends of forged steel, welded together. Plates of proper width were shrunk around this core. All scrap is eliminated.

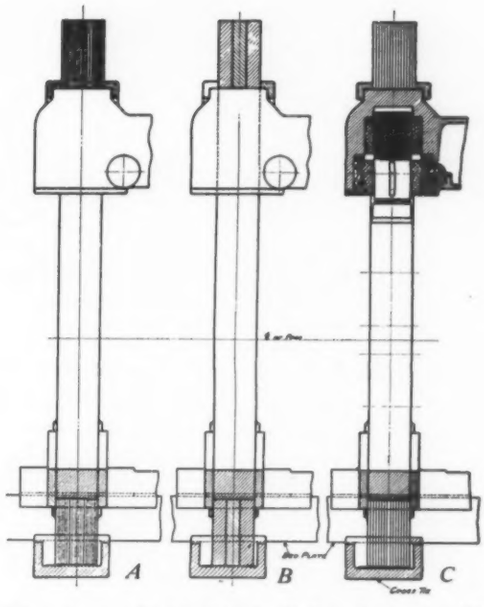


Fig. 2—A—Eight 1-inch links stacked with 1½-inch side links saves machining. C—First plan consisted of 2-inch plates flame-cut to shape and welded along the edges

A fine example of this is the welded steel mill housing shown. The essential element in a mill housing is a closure which will confine the rolls to vertical alignment and permit of vertical adjustment and vertical pressure. Obviously, a rectangular closure would be a poor one from a standpoint of stresses, so by rounding the ends we have an elongated link and by inserting a screw pack between the rolls and the inside top of the link it fulfills all the requirements.

This job is also an example of the help the steelmaker can give the designer if he is acquainted with all the factors involved. The housing was designed originally for plates 2 inches thick, Fig. 2*C*, but on account of the great percentage of scrap and excessive machining, it was suggested it be made of thick forgings, Fig. 1, in which case an allowance could be made on the material cut from the center.

MACHINE DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

Standard Inquiry Forms Aid Customers In Expressing Wants Clearly

MACHINERY and equipment manufacturers frequently receive inquiries so lacking in information that quotations or other desired data cannot be furnished intelligently. The manufacturer can guess at what the inquirer wants, can supply information to fit several cases—trusting the inquirer to select the right one—or he can write for additional specifications. In any event, time will be lost and misunderstandings may arise.

Recognizing the unsatisfactory results of this loose method, members of the American Gear Manufacturers association have approved as recommended practice a series of standard specification or inquiry forms to be used in obtaining cost and other information from gear manufacturers. The forms are comparatively simple and provide for all the dimensions and other data required by the manufacturer to quote or fill orders in exact accordance with the wishes of the customer.

The advantages of standardized specification forms are so obvious that it is surprising they have not been adopted more generally throughout industry. Aside from greatly simplifying the work of the manufacturers, the new plan will help customers to specify their wants more clearly and thus will insure their receiving better service and greater satisfaction.

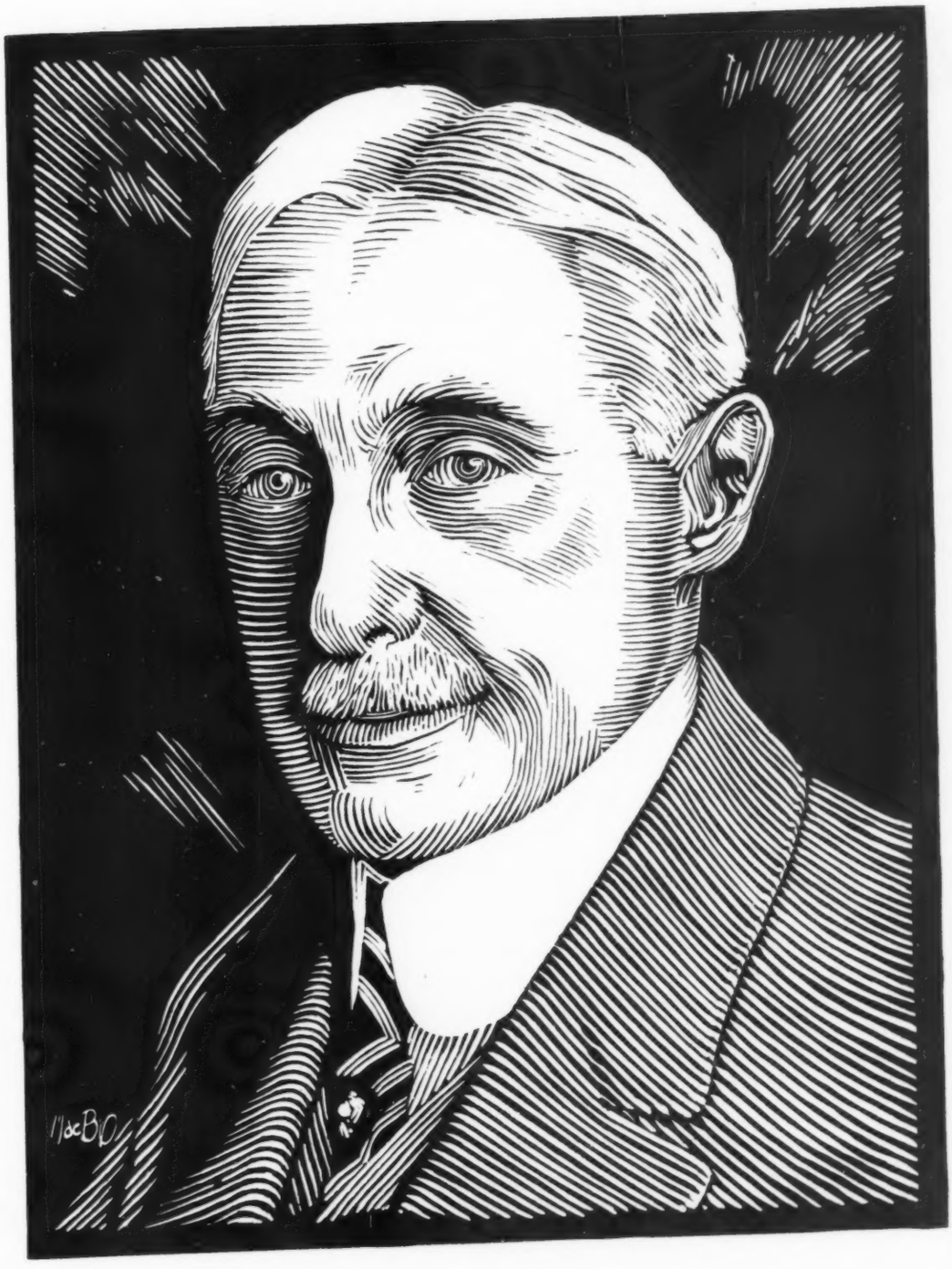
Gear manufacturers are to be congratulated upon their progressive action in approving standardized specification sheets. It is a practice which manufacturers in many other divisions of the machinery and parts industry could adopt profitably.

• • •

Smash the Fake Invention Racket!

APPARENTLY the depression has not interfered seriously with the business of certain promoters who, in the guise of scientists or engineers, solicit money for stock in enterprises alleged to be engaged in perfecting "perpetual motion" or other machines of doubtful merit. Recent advices indicate that this racket is being worked energetically in the West Central states.

This type of promoter usually affixes a dignified doctor's degree to his name; makes frequent and liberal mention of personages such as Edison, Ford, Carnegie, Westinghouse, etc.; and refers to his inventions in vague but laudatory terms. The concern of engineers in this racket is warranted by the fact that the activities of these pseudo-scientists tend to discredit the profession in the minds of laymen. Engineers will do well to investigate questionable cases and to help in exposing fraudulent practice. It is so difficult to obtain financial support for worthy scientific development that it is a shame that money available for such investment so often gets into the hands of racketeers.



Elmer Ambrose Sperry

Master Designers

Elmer Ambrose Sperry

SAFETY and comfort. No other two factors are as important in transportation, and no other man has contributed as much to the advancement of these two requirements as Dr. Elmer Sperry. Intensely practical, this man sought out needs and satisfied them with efficient devices. Probably the best known of his contributions are the gyroscopic compass which provides accurate direction regardless of forces which might affect magnetic compasses, and the gyrostabilizer for damping the roll and pitch of ships.

HIS work was not confined to marine fields, however, even though these developments are the best known and include in addition to those given, a pitch and a roll recorder, an automatic steering mechanism and a system of gun fire control. Sperry designed, built and improved electric locomotives, street cars and electric automobiles. He devised a diesel engine for aircraft and he was the pioneer in gyroscopic aircraft instruments including the turn indicator, directional gyro and artificial horizon.

THE first electric chain-cutter mining machine, designed by Sperry, won several competitions, and his genius found further outlet in the development of detinning and electrochemical processes and machinery for making fuse wires. Safety and comfort on railroad lines were advanced by Sperry's detector car which locates hidden fissures in rails, and his track recorder car for determining the ridability of railroad tracks. His work included arc lights, high intensity search lights, submarine detection devices and other mechanisms designed for the Naval Consulting board.

THIS man, who as a boy in Cortland, N. Y., where he was born in 1860, was intensely interested in mechanical contrivances, was a staunch supporter of trade associations. He was instrumental in the founding of National Electric Light association, American Electrochemical association, and American Institute of Electrical Engineers. His genius did not go unrecognized; at the time of his death, in 1930, he had received some of the highest honorary and scientific awards that are presented in this and other countries.

PROFESSIONAL VIEWPOINTS

Publication of letters does not neccessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Welcomes Letters or Solutions to Problems Suitable for Publication

A Designer's Association?

To the Editor:

WE ARE wondering if you can give us any information regarding the American Designer's association. We are having some dealings with an individual who talks of being a member of this association. As we recall the details given in a conversation, this organization has some 2500 members who are elected to membership only to fill vacancies created by a death. The headquarters are located in Philadelphia, where a huge building is occupied. In this building each member has a large locker in which he files blueprints, notebooks and models of inventions. There is also a large warehouse available for the storage of completed devices. Upon the death of a member, the organization appoints one from among its members to take over the work and complete the inventions. The association is supposed to include every outstanding inventor, scientist and electrician. Men like Edison, Ford, Steinmetz and others were mentioned among its members.

—RICHARD ROE

EDITOR'S NOTE—As far as we have been able to discover, there is no such organization as the utopian group named in this letter. It would appear that this is an ephemeral group created by the individual who claimed membership in it.

Redesigning Gear Trains

To the Editor:

IN THE May issue of MACHINE DESIGN, Forrest E. Cardullo presented a most interesting history of the development of a special gear drive in which was combined an analysis of the acting forces, recognition of the smoother action of gears in the arc of recess, and sensible departure from the use of standard gear proportions.

I must protest, however, against the improper indication of the angles of approach and recess in Figs. 3 and 6. The angle of approach is the *angle turned through by the gear* from the time a tooth comes into contact until that tooth is in contact on the pitch line (or line of centers). Similarly the angle of recess is the angle turned through by the gear from the time that a tooth is in contact on the pitch line until that tooth leaves contact. In order to measure the angle turned through by the gear we must measure successive positions of the same point, such a convenient point being the pitch point on the acting face of the tooth.

Incorrect Angle Measured

Instead of doing this Mr. Cardullo has drawn a radial line from the point where contact ends, and called the angle between this radial line and the center line the angle of recess. Obviously this is measuring the angle between the position of the pitch point of the tooth in one position and the tip of the tooth in the final position. The same criticism applies to the angle of approach.

Proper procedure would be to draw the acting tooth form through the three successive contact points and then draw radial lines from the points where these tooth forms cut the pitch circle. Then the enclosed angles would be the proper angles of approach and recess.

Fortunately this error does not invalidate Mr. Cardullo's conclusions about the increase in the angle of recess with increase in the addendum. In fact, the true angles of recess are greater than he has shown them.

—E. S. AULT,
Cleveland

To the Editor:

PROF. E. S. Ault's definition of the angle of approach and recess is more logical than the definition to which I am accustomed, which was taken from Prof. Sibley's *Pure Mechanism* and appears on page 190 of the 1914 edition. I admit that I am to be criticized for not having consulted more authorities in this matter, but remembering the figure in the text book, which I used when I was teaching, I indicated the angles

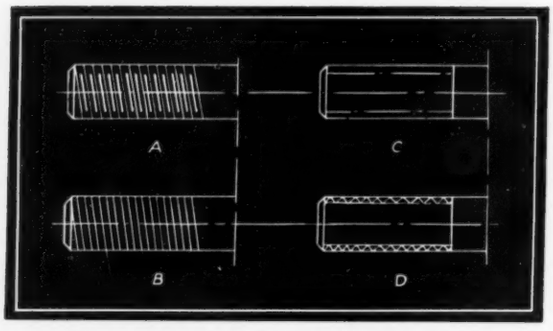
in the manner shown in my drawings. It is fortunate that the amount of the error is insignificant and has no appreciable bearing on the practical value of the article.

—Forrest E. Cardullo,
Cincinnati, O.

Standardizing Thread Symbols

To the Editor:

WOULDN'T it be a good idea to standardize on thread symbols used on engineering drawings? A good standard, properly conceived, would reduce drawing time, simplify translation of the drawing, and thus clarify the whole situation. In the accompanying drawing *A*, a commonly used symbol, takes too much time to produce; *B* is open to the same objection and looks less like a thread; *C* is used widely in Europe, but reminds one of shorthand—it always must carry some identifying note. I would suggest *D* as the best symbol. It approaches the ease of production of *C*, and is made by merely adding the freehand wavy lines. It really conveys more of a thread picture than any of the others. I have been using it successfully for about three years.



Standardized thread symbols would save time and simplify task of reading drawings

—John S. Carpenter,
York, Pa.

Create Bushing Standards!

To the Editor:

WHILE no American standard in the field of bearing bushings, discussed in previous issues of Machine Design has been developed as yet, it may interest some readers to know that national standards for bearing bushings have been established in Germany.

One of these standards gives a series of 603 thin-walled bushings with 78 bores, 10 to 250 mm.; 8 thicknesses, 3 to 10 mm.; and 26 lengths, 10 to 400 mm. Another gives a series of 567 thick-walled bushings with 73 bores, 10 to 200 mm.; 14 thicknesses, 4 to 15 mm.; and 26 lengths, 10 to 400 mm.

A canvas of industry was made by the German national standardizing body as to whether these two series, comprising altogether 1170 different bushings, had been found to cover the needs of all users of these bushings satisfactorily. The reply was in the affirmative. It also was stated that, as a matter of course, bushings differing from those listed in the standards mentioned must be used in some special cases. However, these are so rare as not to warrant any additions to the present series.

No Bushing Material Specified

No material is specified for the bushings in question, but they are understood to be meant primarily for use with bronze.

There is still another German standard which lists 164 different cast iron bushings with babbitt lining. These bushings have 46 different bores, 15 to 150 mm.; 41 outside diameters, 32 to 200 mm.; and 19 lengths, 45 to 400 mm. The thickness of the babbitt lining is given for each bushing, but this figure is meant to serve only as a guide and need not be maintained strictly.

A few years ago the writer was told by the standards engineer of a large American company manufacturing machine tools that it had on record about 4600 different bronze bushings which had been used in the course of time in the machines built. This was mentioned as one of the cases where the need for standardization of component parts, including a considerable reduction in different sizes, was indicated. If such a condition in a single company is compared with that in Germany where the needs of the entire national industry are practically covered by less than 1200 bearings, it seems safe to conclude that if all those in the United States who make or use bearing bushings got together, they probably would be able to agree on a national standard of bushings giving a limited series of bearings that would cover most of the practical requirements.

The American Standards association is ready to lend its assistance to any effort that industry may wish to make in this direction.

—John Gaillard,
New York

Editor's Note—Copies of the German Standards referred to in this letter are available as a loan, or for sale, at the American Standards association, 29 West Thirty-ninth street, New York.

Careful Design Prolongs Packing Life

(*Concluded from Page 30*)

or ram. *B* is the packing itself and *C* the inside follower plate. The most important requirements of the back follower plate, *A*, are that it should be perfectly flat and must be a snug sliding fit in the cylinder in which it travels. Many packing installations have a back follower plate which has a radius on its edge to conform to the original shape of the packing. This radius is entirely unnecessary as the packing soon flattens out under pressure and the knife edge created by this radius tends to cut into the packing.

The chief requirements of the inside follower plate, *C*, are: It should be approximately as high as the lower corner of the lip of the packing as shown in Fig. 4. If the inside follower plate is too shallow it is liable to permit the lip

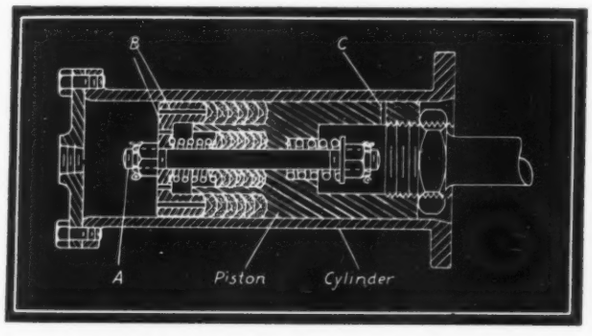


Fig. 5—Patented method of applying V-type packings makes use of expander rings

of the packing to collapse and allow the pressure to pass.

EXPANDERS. There are a number of patented methods of applying packings which make effective use of expanders. One of these is shown in Fig. 5. Rod *A* will be moved down with the expander by the pressure in the cylinder in proportion to its area, thereby expanding the packing against the cylinder walls. Pressure on the packings is permitted through holes *B* while hole *C* prevents the building up of pressure which might leak past the inside of the packing.

PACKINGS. Some kind of inside expander or follower ring always should be used on a U-type packing to prevent the collapse of the side walls of the packing. A flax or tucks filling sometimes is used or a complete bronze follower ring which extends to the bottom of the packing can be employed. It must be remembered that tucks is made of fabricated rubber and should not be used in oil. Whether the medium is oil or water, it will not affect fiber, metal or leather of special mineral tannage. In any event, this filling should not fill the inside of the packing completely, but should leave the upper part of the lip free so that the pressure can enter.

A good design of packing installation is shown in Fig. 6. The gland ring should be square and not concave as shown at *B*. When the gland ring is concave there is a tendency to cut the shoulder of the U. Many believe that by cutting the gland ring to fit the shoulder of the U the packing will seat better and cause a better seal. This is not the case as the packing will

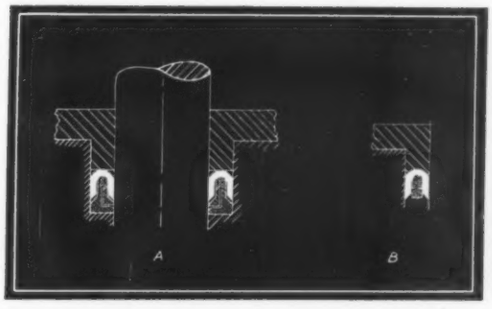


Fig. 6—Some kind of inside expander or follower ring is necessary with U packings

always take the shape of the gland ring or seat as soon as the pressure is applied.

COIL, BRAIDED TYPES. Of additional importance to the designer are the packings used in stuffing boxes. For the type of packings which consist in general of ordinary braided, wrapped or molded coil, spiral and ring packings of either round or square cross sectional shape, stuffing boxes should be designed as follows:

> Stuffing box diameter should be approximately rod diameter in inches $\times$ 1.22 + 0.6 inch. (The result so obtained should be increased to the next higher common fraction in eights)
>
> Stuffing box depth should be approximately six times the width of the packing space. (Difference between rod and stuffing box diameters).
>
> When beveled, the angle of the stuffing box or gland should be 30 degrees. The depth of the bevels should be added to depths obtained by following the preceding rule.
>
> If water seal or oil lantern is to be used, stuffing box depth should be increased accordingly.

For assistance in the collection of material for this article and for the illustrations used, MACHINE DESIGN is indebted to: Armstrong Cork Co.; American Felt Co.; Garlock Packing Co.; E. F. Houghton & Co.; and Chas. W. Marsh Co.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Cork Becomes Increasingly Popular as Design Material," by Allen F. Clark, Sept., 1931, p. 37.

"Protecting Bearings with Unit Oil Seals," Aug., 1932, p. 30, Oct., 1932, p. 30.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

Changes in Sewing Machine Design Are Indicative of Progress

CONTRAST between the old and the new is perhaps no more outstanding than in domestic units, particularly the sewing machine. The awkward and bulky model of grandmother's day has given way to a handsome, neat and compact console model, characterized by its silent operation, electric drive and speed controls. One popular make recently introduced a stitch regulator and direction control. By touching a small conveniently located lever the machine reverses, thus enabling the operator to sew forward or backward. Another new feature is a hinged presser foot which adjusts its position to the thickness of the cloth. New ideas in threading and bobbin winding also are incorporated.

* * *

Wide Interest Shown in Course on Designing for Welding

COMPLETION of the recent one-week condensed welding course given in Cleveland by the John Huntington Polytechnic institute and the Lincoln Electric Co. was marked by the largest attendance of any of the four similar courses given during the winter. Included in the registration were men from Germany, Japan and Sweden as well as from ten different states. The success of these one-week courses in designing is indicative of the interest displayed in the subject by engineers responsible for design of machinery. The courses will be repeated next fall.

* * *

Thirty-One New National Industrial Standards Listed in Yearbook

RECORDED in the American Standards yearbook published recently by the American Standards association are 31 new national industrial standards affecting electrical, mining, oil, steel, radio and almost every other major industry. The book is issued as a record of the co-operative achievements of nearly 3000 scientists and engineers representing more than 500 national technical and trade organizations. This compilation reveals that the work which started in 1918 has gone on without abatement during the past few years despite the depression.

* * *

Prepare Recommended Course in Foundry Practice for Schools

UNDER the sponsorship of the American Foundrymen's association a joint committee on foundry education in engineering schools recently published in mimeographed form a recommended course in foundry practice for engineering schools. This was prepared with the idea of strengthening courses in this type of instruction already being administered in various collegiate institutions and is arranged to give engineering students the type of information and knowledge of value to the engineer in the design and use of castings.

* * *

Kettering Believes in Trying Foolish Things Once in a While

PROBABLY the most widely quoted research engineer is Charles F. Kettering. When he voices his pithy, pointed declarations, engineers over the country lend their ears. Recently he addressed American Iron and Steel institute in New York and gave the steel industry some of his philosophy.

He defined research as "not a thing that has to do with today or tomorrow, but with the general trend of the industry over a much longer period of time." Pointing out that "usually we expect to get too quick results on any research setup," he added: "I think that I can make any research in any industry pay for itself if you will give me four years' start, because it takes about that long to discover the fundamental problems in any industry." Mr. Kettering ad-

mitted that many practical results of research have been attained by accident. He believes in using the best factors in science and mathematics and then in trying some foolish things once in a while. Unless projects are kept out of the beaten path the term "research" does not apply.

* * *

Talking Book Has Words Recorded on Spool of Magnetized Wire

TALKING books . . . these along with practical television are not far away in the opinion of Dr. William F. Ogburn, noted sociologist of the University of Chicago and director of research for the committee which drew up the report on "Recent Social Trends" during the Hoover administration. Experiments now are being carried on with the talking book device. Recording words of a book upon a spool of magnetized wire is another development made possible by the electron tube. The spoken words are impressed upon the wire as changes in magnetization. By running the wire through a suitable machine connected to radio amplifiers and a loud speaker the contents of the composition are repeated. When this becomes practical a more compact method of preserving mankind's literary work will have solved one of the important library problems.

* * *

Public's Wants Should Be Regarded As Most Important Survey Now

WHAT our country needs most is a study of the wants of the people, both present desires and probable future requirements, rather than a survey of the sources of power or the study of ergs and joules, watts and calories. This statement from an engineer like J. S. Tritle, Westinghouse vice president, catches attention.

Other comments in his recent presidential address before the National Electrical Manufacturers association were typical of this: "Certainly the troubles of 1820 could not be blamed on mechanization because it had not yet begun. Yet the country was relatively in worse distress than today and even a greater percentage were unemployed. From government statistics we find that in 1889 there were 69 human workers of each 1000 of population employed in manufacturing industries in the United States. In 1929, after 40 years of mechanization, there were 72½ workers in these same industrial groups for each 1000 of population. In this there is no evidence of a decline in the need for man power."

* * *

All Known Chemical Elements Collected in One Place for First Time

OF THE thousands of exhibits which feature the Century of Progress exposition opened recently in Chicago, the sweeping panorama of scientific achievement bids well to hold one of the greatest attractions for visitors. In the Hall of Science, there is set up a huge "Periodic Table of Elements," in which is collected in one place for the first time specimens of all the known chemical elements. In the search for these specimens it was found that the Union Carbide & Carbon Corp. was the only practical source of a large percentage of the ninety-two elements. Accordingly almost half of these were furnished by the company to the fair management for this basic science exhibit.

* * *

Valuable Equipment in Russia Ruined by Ignorant Workers

SOVIET Russian official circles are reported to be showing signs of disturbance over replacements of imported industrial equipment. Damage and deterioration to valuable equipment came about through its handling by ignorant peasants called into mills and shops from the farms. Technical knowledge with such workmen is not to be expected. It is said that machinery built by British, German and American manufacturers has been sadly wrecked. Delicate equipment of the most modern type is becoming chronically, out of order. This is however, exactly what well-posted American engineers expected would happen to the $750,000,000 worth of imported equipment bought by soviet Russia in laying out its five-year plan.

* * *

Nickel Chromium Cast Iron Piston Rings Effect Economy

SUBSTANTIAL economies are reported by an eastern oil refinery as a result of adoption of nickel chromium cast iron for piston rings. Rings produced from a suitable base mixture containing 1.50 per cent nickel and 0.45 per cent chromium have lasted 13 months, as compared with 6 weeks for conventional gray cast iron.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

MULTIFARIOUS activities in business, civics, political science, mechanics, etc. comprise the record of James Hartness who recently retired as president of Jones & Lamson Machine Co., Springfield, Vt. Since 1890 he has been associated with the company, first as superintendent, then manager and finally president. The latter office he held for 32 years, relinquishing its duties to Ralph E. Flanders, whose picture and biographical sketch appeared in MACHINE DESIGN for Oct., 1929, page 46. Mr. Hartness' career has been replete with mechanical inventions for which he has obtained over 100 patents.

Life for Mr. Hartness began in Schenectady, N. Y., Sept. 3, 1861. A degree in mechanical engineering at University of Vermont, a master's degree at Yale and the L.L.D. from Norwich university and University of Vermont bear witness to his scholastic training. He has served as governor for the State of Vermont, is a past president of the American Society of Mechanical Engineers, and of the American Engineering Council, fellow of the American Association for the Advancement of Science, and member of many other organizations.

The flat turret lathe, a screw thread comparator and an automatic die are among his outstanding contributions as a designer. He also has won wide recognition as the author of "Machine Building for Profit," "Flat Turret Lathe Manual," and "Human Factor in Works Management." As a medalist he likewise holds distinction.

ENGINEERS in many branches of the profession are looking forward to the Edgar Marburg lecture this year at the annual meeting of the American Society for Testing Materials. They will hear Dr. H. J. Gough deliver it, the subject being "Crystalline Structure in Relation to Failure of Metals Especially by Fatigue." With a distinguished record as a scientist, this authority is renowned for his work in connection with the study of strength of single crystals.

Dr. Gough is superintendent of the engineering department, National Physical Laboratory, England. At the age of 43 he is the leading investigator in the field of relation between atomic structure and physical strength of metals. It was in 1914, after serving an apprenticeship and subsequently becoming a designer with Messrs. Vickers Ltd., London, that he joined the scientific staff of the Engineering department of the National Physical Laboratory.

During the World war he saw active service in France and Belgium and on his return to England was reappointed as scientific assistant in the Laboratory in May 1919. A series of promotions followed and in December, 1930, he was made superintendent, Dr. Gough has been awarded several degrees by English universities and he is a member of many of the leading scientific societies.

PROGRESS has invested the refrigerating engineer with new responsibilities. . . it has charged him with the task of helping to raise our standards of living by providing more economical domestic and commercial units. Even in the mechanical industries refrigeration has been employed to facilitate methods of shrink fitting machine parts (M. D., May, p. 17).

Among those refrigerating engineers who have been leaders in promoting the development of the art is Alfred W. Oakley, new president of the American Society of Refrigerating Engineers. A native of New York City where he was born in January 1892, Mr. Oakley studied at Cooper Union for three years. He was employed by De La Vergne Machine Co., Port Morris, N. Y., as draftsman in 1913, later assuming responsible charge of ice plant design and application of refrigeration for industrial purposes. Since 1918 he has been associated with the Merchants Refrigerating Co., New York, and now is manager of the technical department.

CONTINUOUS service of more than 35 years with one organization attests to a man's loyalty and ability. Such is the record of Albert G. Davis, retiring General Electric vice president in charge of patents, now associated with a

Leaders in Design, Engineering and Research

JAMES HARTNESS

HERBERT J. GOUGH

ALFRED W. OAKLEY

ALBERT G. DAVIS

New York law firm that specializes in patent work.

Bangor, Me., was the place of his birth in 1871. After graduating from Massachusetts Institute of Technology in 1893 he held a position in the United States patent office as an examiner from 1894 to 1896. Resigning from this work he opened an office in Washington as a patent attorney and in this interval handled some patent work for the General Electric Co. In December 1897 he accepted the post of manager of the company's patent department.

The electrical industry at that time was entering upon its great tide of pioneer development, a trend which kept up for 25 years. Grist of inventions was enormous and the responsibility of discerning which in years to come would be indispensable and which were relatively unimportant was a heavy one. This work, however, was painstakingly directed by Mr. Davis and he carried it forward with pronounced success. In recognition of his record he was appointed vice president of the company on Nov. 21, 1919.

* * *

E. W. Miller, chief engineer, Fellows Gear Shaper Co., Springfield, Vt., was re-elected president of the American Gear Manufacturers association at the recent annual meeting at Wilkinsburg, Pa.

* * *

H. H. Moss, engineer, Linde Air Products Co., New York, was awarded the Samuel Wylie Miller medal for his achievement in the application of fusion welding and oxyacetylene flame cutting. He has been particularly active in the development of flame machining.

* * *

Commander Jerome C. Hunsaker, vice president, Goodyear Zeppelin Corp., Akron, O., has been awarded the 1933 Daniel Guggenheim medal in recognition of his notable achievement in the advancement of aeronautics.

* * *

Charles E. Tullar, manager of the General Electric patent department, recently was appointed a member of the advisory committee and of the engineering council of the organization.

* * *

Prof. T. R. Lawson, Rensselaer Polytechnic institute, Troy, N. Y., recently was nominated for president of the American Society for Testing Materials.

* * *

A. E. Drissner, chief engineer, National Acme Co., Cleveland, since 1916 when it took over the Windsor Machine Co., Windsor, Vt., has been appointed vice president in charge of engineering, following the consolidation of the company's two plants in Cleveland.

* * *

Harry W. Dietert, formerly chief industrial research engineer, has been made chief engineer of the United States Radiator Corp., Detroit.

* * *

John G. Wood has been appointed assistant chief engineer of Chevrolet Motor Co., Detroit. He formerly was chief engineer of the Olds Motor Works, Lansing, Mich. C. L. McCuen is succeeding him in that capacity at Olds.

* * *

Dr. W. H. Hatfield, director, Brown-Firth Research Laboratories, Sheffield, England, and technical advisor to Thomas Firth & John Brown Ltd., recently received the Bessemer gold medal for 1933.

* * *

Charles E. Wertman has succeeded the late Clarence E. Whitney as president of the Whitney Mfg. Co., Hartford, Conn. He has been connected with the organization for 17 years.

* * *

Forrest Nagler, mechanical engineer, formerly a staff executive of the A. O. Smith Corp., Milwaukee, has become associated with Allis-Chalmers Mfg. Co., Milwaukee.

* * *

Charles S. Davis, president of Borg-Warner Corp. and vice president of Warner Gear Co., Muncie, Ind., was elected president of Warner Gear Co. recently to succeed the late Roy P. Johnson.

* * *

R. E. Hellmund, since 1921 engineering supervisor of development for Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed chief engineer. He is the first Westinghouse executive to hold this office since the death of B. G. Lamme in 1924. A picture and biographical sketch of Mr. Hellmund appeared in the Feb., 1930, issue.

* * *

F. P. McKibben has been re-elected president of the American Welding society. His picture and biographical sketch appeared in the July issue, page 44.

* * *

F. W. Peek, chief engineer, Pittsfield Works, General Electric Co., has been appointed by the United States national committee of the Inter-

national Electrochemical commission as its representative on an international subcommittee of the A. S. A. advisory committee on rating of electrical machinery and standard voltages and codes.

* * *

Frank G. Alborn has succeeded H. D. Church as chief engineer, White Motor Co., Cleveland.

* * *

Dr. J. Brownlee Davidson recently was unanimously selected by the jury of awards of the American Society of Agricultural Engineers as the recipient of the 1933 Cyrus Hall McCormick medal.

Re-engineering To Meet New Conditions

CHANGED conditions wrought by an abnormal period of business have forced industry to take new account of itself and effect a revision of design, production and marketing methods. Recognizing this need Case School of Applied Science in collaboration with national engineering organizations and the Cleveland Engineering society held a re-engineering conference May 11 and 12. Its purpose was to bring executives and engineers together for a discussion of some of the important factors that will bear a direct influence on future business and industrial activity.

From the standpoint of the designer one of the most outstanding papers was presented by R. E. Hellmund, chief engineer of Westinghouse. The keynote of his paper was products redesign to increase appeal to the purchaser. The time is ripe, the author believes, to shift emphasis from certain types of sales appeal to others which previously have not been given sufficient consideration. For purpose of discussion he outlined his choice of the principal items which generally are considered essential in sales appeal, classifying them as follows:

1—Serviceability and performance
2—First cost
3—Operating economics
4—Reliability and expected life
5—Convenience
6—Appearance

Although, obviously, the importance of these items varies greatly both with the product and prevailing conditions, the order in which they are given in this list indicate their relative importance to the purchaser in the case of many of the more technical products. It is evident that the various features connected with the service to be performed are of prime importance. As a second consideration, the purchaser naturally is interested in obtaining such services at the lowest cost. Convenience and appearance are listed last because with technical products their actual inherent value to the purchaser usually is less than that of other features.

In the case of less technical merchandising articles, particularly if they are of the semi-luxury type and frequently used as gifts, the relative importance of the items entering into sales appeal may be entirely different, perhaps somewhat as indicated in the following list:

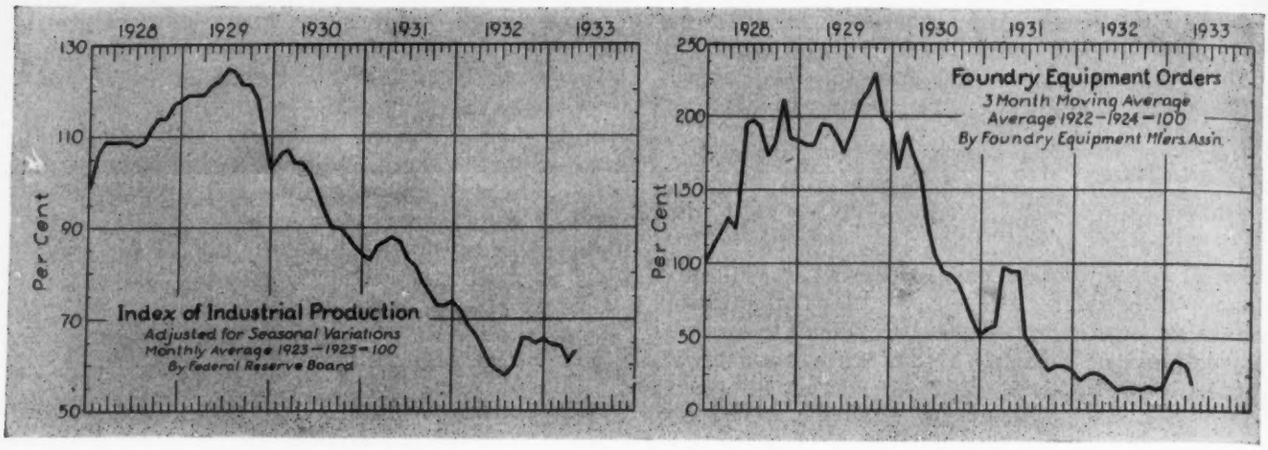
1—Serviceability and performance
2—Appearance
3—Convenience
4—First cost
5—Operating economics
6—Reliability and expected life

Even with numerous products of a purely technical nature for use in industry, a radical change in the attitude of the designer may be necessary. There are many such products where serviceability, low first cost, satisfactory operating economics and reliability have been worked out to such a high degree of perfection that at this time the most promising possibility for increasing sales appeal seems to be through greater convenience and better appearance. The designer, therefore, without losing sight of other important factors, must devote his main attention to these latter items.

Economical production of extremely precise parts, in this case ball bearings, was described by Thomas Barish, Marlin-Rockwell Corp., Jamestown, N. Y. To understand the special machinery and special production methods employed to make precise parts economically requires thorough and painstaking analysis of the precisions required. Each tolerance should be set close enough but not too close for commercial purposes, he declared.

The best proof of the advantage of stampings in preference to almost any other method should be the fact that with few exceptions the modern designer will consider the use of stampings first, the paper prepared by J. K. Olsen, Stewart-Warner Corp., Chicago, set forth. Extensive ingenuity constantly is being employed in this redesigning. Parts of products for which the use of stampings could not have been conceived a few years ago, are today redesigned to employ them. Progress in manufacturing methods such as electric welding also are contributing factors to the increasing use of stampings in design.

And speaking of welding Robert E. Kinkead gave a well directed paper on the influence of welding on design and production. In referring to the purpose for which the conference was conceived he declared that re-engineering should cure industrial management of the folly of trying to sell what its plants can build rather than trying to supply wants at a price the customer can afford to pay.

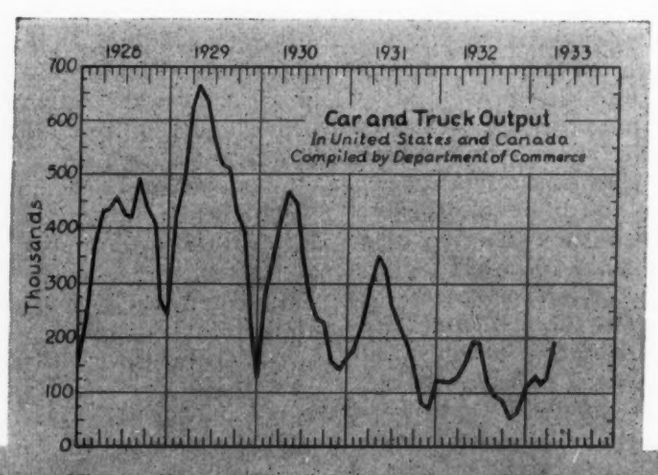


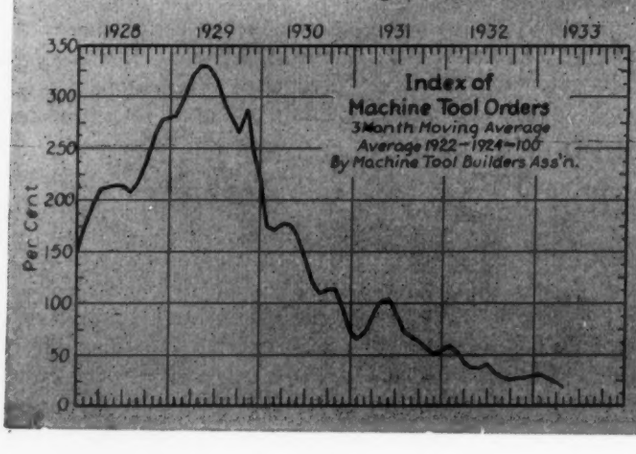
How Is Business?

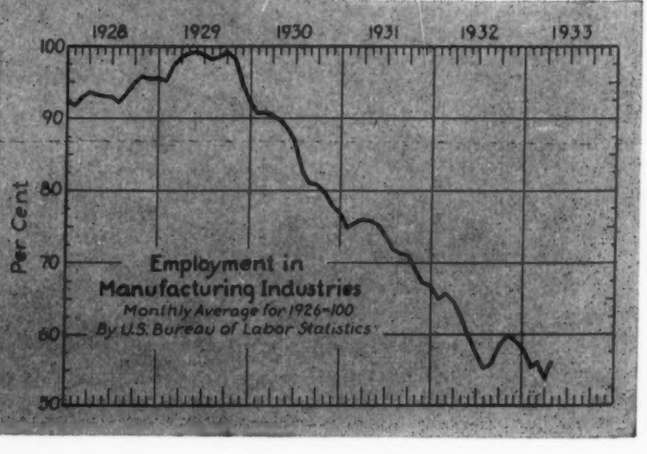
MANY persons have found it difficult to believe that business is actually improving—personal conditions with which they are acquainted naturally overshadow the overall picture. It seems as though some genii magically brought about the advance in indexes, as the upturn has not benefited them.

However, the curious individual who scans the "Help Wanted" columns in the daily newspaper of a large city will find ample proof of the advance. Here, for the first time in years, may be found requests for designers, tool and die makers, machine operators and men experienced in similar trades. The need must be imperative when a manufacturer finds that he must advertise for such employes rather than recruit them from his former workers or from the long line of applicants that for years besieged his door.

Another visual sign of improvement will come to the attention of anyone traveling the national highways leading out of Detroit. These main traffic arteries are thronged with new automobiles on trailers, under their own power, under the custodianship of a new owner or similarly being conveyed away from the factories which are now working with greater activity and zeal than was thought possible a short time ago. Men are at work again, and working men spend more money.







NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

GLASS technology has reached new levels of refinement through the guiding genius of designers who have contrived automatic machinery by which higher production and accurate formation of articles are obtained. Simplicity and compactness are extremely influential factors in the design of this type of equipment (M. D., Feb., p. 13). Speed and automaticity constitute two important others as revealed by the unit for forming glass stoppers for which a patent, No. 1,906,561, recently was granted to Floyd Flexon. Owens-Illinois Glass Co., Toledo, O., is assignee.

In the newly patented machine, Figs. 1 and 2, stopper molds are carried in a circular path on a central column, receiving charges of glass 14 as they pass the opening of furnace 13. These stopper molds comprise a neck mold plate 20 provided with an annular series of vertical openings. Head mold groups 22 are arranged in a corresponding series beneath the neck mold cavities and together they form the glass stopper. The head molds are arranged to be moved vertically into and out of position. This movement is obtained by mounting each head mold plate 23 having a series of recesses 24, on a pair

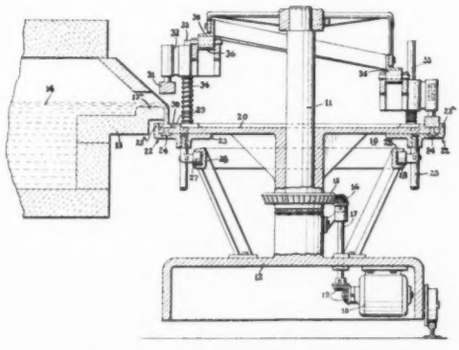


Fig. 1—Continuous flow of glass is handled by this glass stopper molding machine

of guide rods 25 suspended from neck mold plate 20.

A roller 27 is carried by each head mold plate 23 and runs in a continuous track or cam 28. This track is so shaped that at regular time intervals it imparts a vertical movement to the head mold plates which contact the lower side of the neck mold plate 20. While the glass is being charged into the neck mold from furnace 13 the head mold plate 23 is in its uppermost position. As the stopper discharge station is

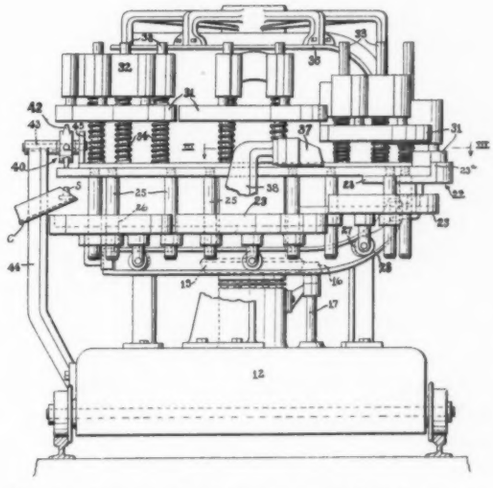


Fig. 2—Cams and springs are employed to control operation of various moving parts

reached, however, the head mold plate recedes to permit fingers 42 of the ejector 40 to depress the stoppers which are transported from the machine by chute *C* as they leave the molds.

Another feature of the machine is the presser head which compacts the glass so that the stoppers will be formed accurately and of uniform weight. Presser bars or plungers 31 are mounted above the neck mold plate 20 and move vertically in and out of channel 30 at regular time intervals. Their movement is controlled through carriers 32 which ride on cam 35. Coil springs 34 encircling the guide rods 33 hold the carriers in their uppermost position during the glass charging period. As the cycle continues the cam forces the carriers downward against the action of the springs. Excess glass on the upper side of the neck mold plate is removed by a knife or scraper 37, Fig. 2.

USE of balls to provide an antifriction thread for shafts provides the basis of a patent granted recently to M. S. McKellar. The balls which roll in mating spiral grooves are restrict-

ed to a limited amount of travel, being interposed between two coil springs, 7, Fig. 3. The springs are housed in groove 3, having their outer ends extended tangentially to the shaft into a recess 8 in the nut. Threaded plug 9 retains the spring in its enclosure.

From the illustration can be seen the action that takes place when the two members are rotated. The nut may be screwed along the shaft easily for a limited distance, the balls compressing the spring at the end toward which they are moved by rotation of shaft relative to the nut. This arrangement is intended for use in valve stems, etc., where the travel is short in either direction.

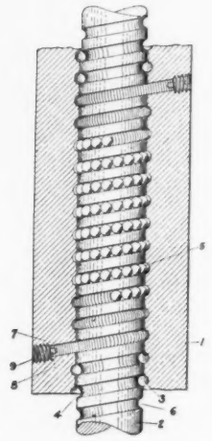


Fig. 3—A series of balls rolling in a channel formed between mating spiral grooves provides an antifriction thread for shafts. Coiled springs hold the balls in position

Hughes Tool Co., Houston, Tex., is assignee of the patent which has been designated No. 1,-905,039.

BY COUNTERBALANCING the gripping dogs of a rotary or free-wheeling clutch, Fred M. Potgieter claims in his recent patent covering a unit of this type that a more efficient device is obtainable. Left and right, Fig. 4 are shown two views of the clutch assembly. Numeral 10 designates the input and 12 the output shaft, this latter having splined upon it at 13 a disk-like frame 14. Member 15 rotates loosely on shaft 10.

Clutch part 20 has a pair of radially opposite areas 21 and 21*a* designed to bind against surface 17 and the opposite surfaces 18 and 19. Gripper 20 is elongated and has a lever part 20*a* extending from its contact areas 21 and 21*a*. Thrust member or strut 22 is seated pivotally in a curved bearing recess 23 in hub 11 and at its other end in lever extension 20*a*. Since strut 22 is in a somewhat tangential position it is apparent that should shaft 10 and hub 11 turn in a clockwise direction, (left Fig. 4) lever extension 20*a* would be pushed radially outwardly causing areas at 21 and 21*a* to bind in grooves 17—18 and 17—19. Spring 30 holds the gripper and strut back as far as they may go, causing areas 21 and 21*a* to maintain frictional contact for immediate gripping action.

The most important feature of the clutch is the means for counterbalancing the gripper or clutch piece 20 against the effects of centrifugal force when the clutch is rotating at high speed. This counterbalance is obtained by employing lever 35 pivoted at 36 upon a pin carried by extension 37 of hub 11. One arm 35*a* has pivotally connected to it at 38 a link 39, which in turn is fastened at pivot 40 to the rear end portion of lever part 20*a*. Point 40 is approximately at or in line with the center of gravity or the center of the mass of the clutch part 20 and strut 22 combined.

The other arm 35*b* of lever 35 has a weight 42. Arms 35*b* is shown longer than arm 35*a*, thus reducing the actual weight of counterbalance 42 necessary to balance the opposing centrifugal force. Centrifugal force acting on weight 42 will tend to draw inward arm 35*a*, link 39 and the whole of clutch part 20 and strut 22.

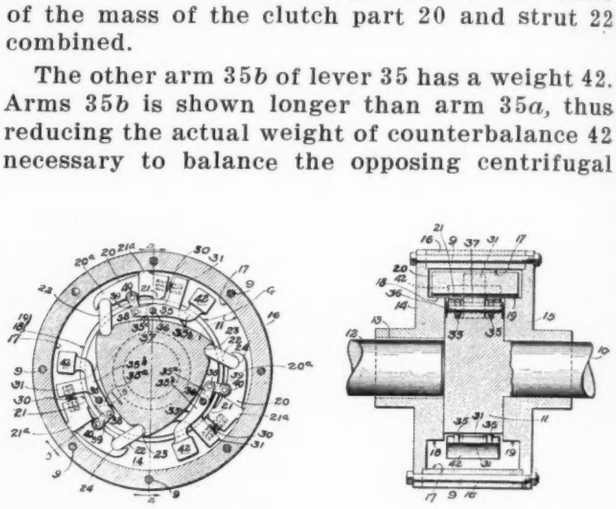


Fig. 4—Rotary clutch embodying counterbalancing means of gripping dogs to overcome objectionable pressure

The patent has been assigned to Universal Gear Corp., Chicago, being identified as No. 1,-906,410.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

CLUTCH—1,896,707—Hanson Clutch & Machinery Co., Tiffin, O., recently was granted a patent covering improvements in clutches, particularly of the friction type.

BREAKER MECHANISM—1,905,096. Outboard Motors Corp., Milwaukee, is assignee of a patent which covers a timer mechanism, the combination with a cam shaft and breaker mechanism including fixed and movable contacts.

MECHANICAL FUEL PUMP—1,905,246. In a fuel pump of the diaphragm type a vapor dome chamber extends upwardly from the pumping chamber and an outlet check valve assembly is secured to the under side of the casing to separate the pump chamber from the vapor dome chamber. Assigned to Stewart-Warner Corp., Chicago.

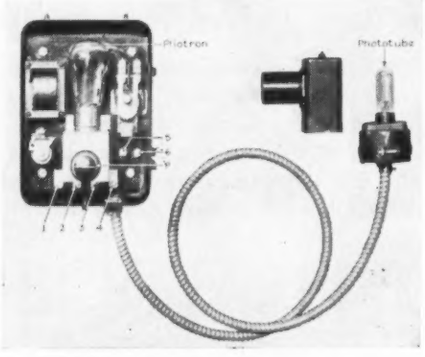
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Photoelectric Relay Improved

AN IMPROVED general purpose photoelectric relay, designated as type CR7505-A4, has been announced by General Electric Co., Schenectady, N. Y. The adjustment knob on the relay, shown herewith, which formerly was located at one side of the tube socket, has been placed in a prominent position on the bracket that supports the tube. This alteration affords easy access to the knob when adjustments are to be made.

Earlier models were designed so that it was necessary to change the wiring connections to cause the relay to function upon the admittance of light when it was wired to operate upon the exclusion of light. A single pole, double throw snap switch now eliminates any wiring changes.



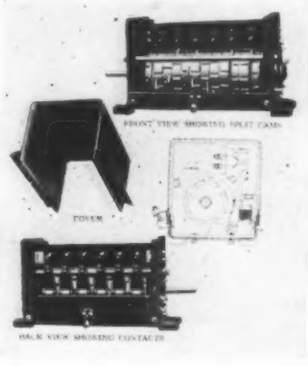
Adjustments are simplified on new type of photoelectric relay

The new relay provides the same sensitive control as its predecessor, utilizing a Pliotron tube, and likewise operates at a minimum light intensity of three-foot candles.

Limit Switch Is Redesigned

TO MEET the need for greater precision on tilt table drives, Cutler-Hammer Inc., Milwaukee, has redesigned its rotating cam limit switch which now has split cams arranged in pairs to give any adjustment between 4 to 8 degrees on the shortest cam, to 180 to 360 degrees on the longest cam without removing or cutting the cam. Only a screw driver and hammer are needed to make adjustments. The cams are of steel, 6 inches in diameter, and any one can be adjusted without disturbing others.

Additional features of the switch include: the large bearings plates opposite the driving end which permit the entire cylinder as well as the pinion to be removed without dismantling; ball bearing camshaft; self-lubricating bearings on the contact levers; and twin break silver to silver contacts.



Cam limit switch has been redesigned to give a greater range of adjustment which can be made more simply

Heater Cord Is Rubber Covered

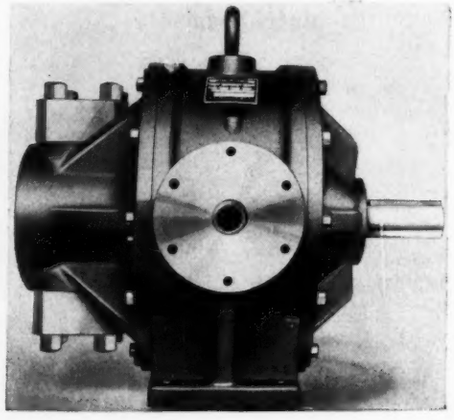
RUBBER covered heater cord for all types of heater appliances now is being manufactured by Belden Mfg. Co., 4689 West Van Buren street, Chicago. The new cord is extra flexible and does not kink. It has no braid to fray or break and is cleaned easily. Individual wires carry the usual asbestos insulation under the overall rubber wall. Furnished regularly with size 16 wire for 1000 watt requirements, the wire carries Underwriters' approval label for 3000 cycle heater cord. Other requirements can be filled on special order.

All-rubber lamp cord, carrying a special luster lacquer finish in old gold, bronze, silver and green colors, is another recent de-

velopment of the company. Any rubber sheathed conductor manufactured by the company can be provided with these special finishes which are applied to the rubber by a specially developed process. The cords have been developed to enable manufacturers to style their machines more completely, so that each machine, cord and plug can be one complete unit in appearance as well as in utility.

Pumps Permit Volume Variation

RADIAL pumps for generating pressure in operating hydraulic powered machinery are available in a complete line from Hydraulic Press Mfg. Co., Mount Gilead, O. This series of pumps is of the positive displacement, multiple



Output of radial pumps is variable in volume and reversible in direction of flow

radial plunger, oil pressure type in which a number of new inventions are incorporated. The output is both variable in volume and reversible in direction of flow, and the pumps are suited particularly for application to heavy duty production machines requiring high pressures.

The pumps are said to have high efficiencies, both mechanical and hydraulic, as well as smooth delivery, vibrationless operation, positive displacement through suction and delivery and a minimum of parts. Six sizes ranging from 1 gallon per minute to 100, with pressure capacities up to 3000 pounds per square inch are available.

Refractory Protects Switch

REFRACTORY protected so as to confine the arc and to obtain longer life with dependability, the new mercury switch announced by Westinghouse Lamp Co., Bloomfield, N. J., is made with nominal ratings from 3 to 50 amperes. The control comprises a new line of single pole, single throw switches which may be operated in either alternating or direct current circuits.

Contact in the switch is made by an impact between two pools of mercury within a refractory chamber encased in heavy glass walls. Instead of flowing slowly together, the mercury from

Impact between two pools of mercury within a refractory chamber encased in heavy glass walls causes contact in new mercury switch

one pool drops to meet the other with a sudden visible "jump." An atmosphere of inert gas within the chamber keeps the mercury chemically pure and prevents the loss of fluidity which might cause it to become gummy and slow flowing. The gas also dissipates the heat of the arc.

Two New Drives Are Available

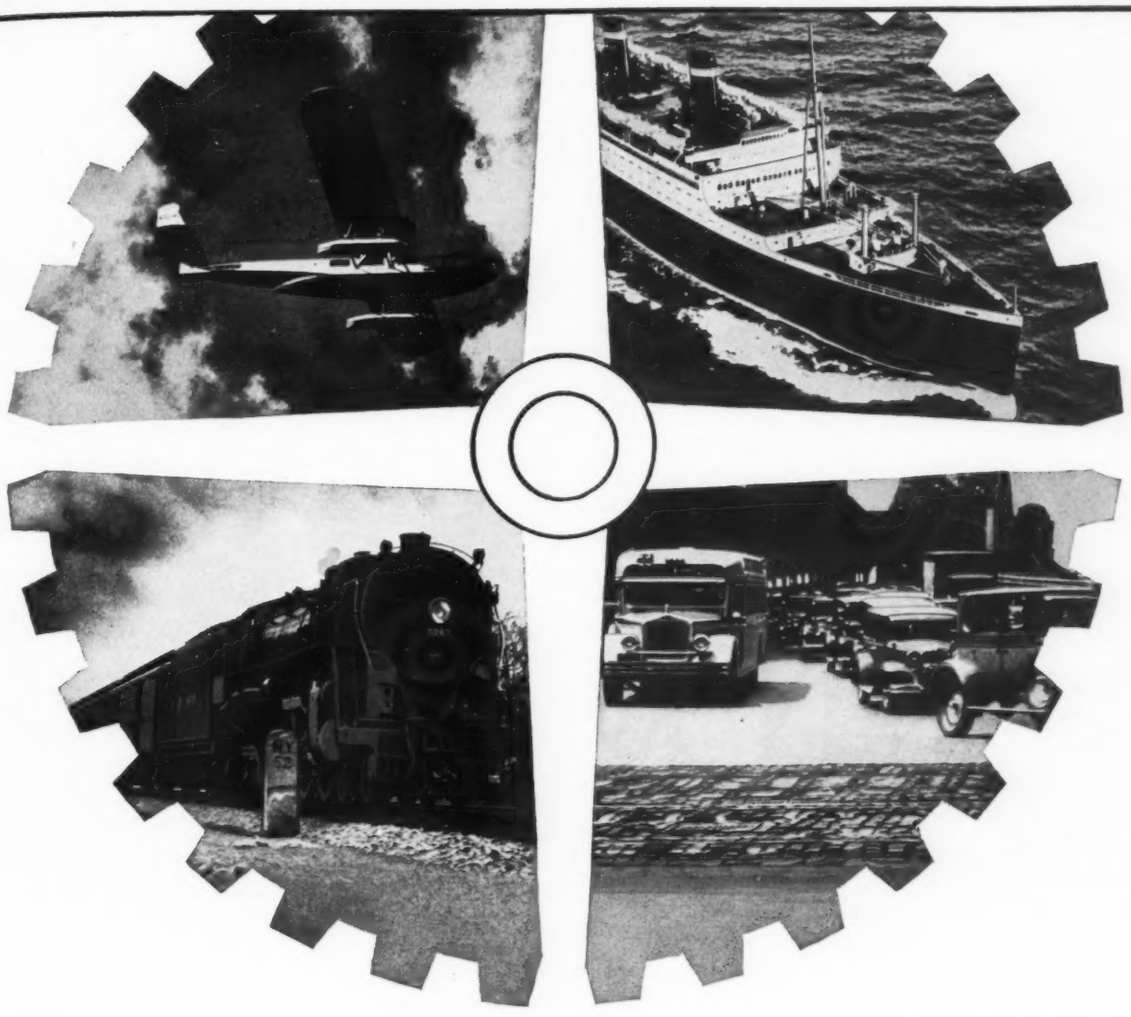
FRACTIONAL horsepower gear-motors with the characteristics and construction of the latest designs of general purpose motors have been developed by General Electric Co., Schenectady, N. Y. The new units combine a light weight, high speed motor drive with a simple

Characteristics of separate motors are available in geared types

reduction gear to make available a wide range of speeds at the output shaft.

These motors are available in two types, both in ratings from 1/6 to ¾ horsepower inclusive. These are the concentric shaft type, shown

MODERN MACHINERY CALLS FOR MODERN METALS



in Transportation...

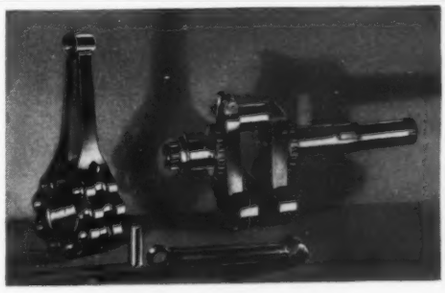
NICKEL ALLOYS *play a vital role!*

SWIFTER AND SWIFTER grows the tempo of modern transportation...demanding machines and materials that must stand greater stresses, greater shocks, greater heat, greater wear.

Superior materials are required to meet these destructive forces. One group meeting these requirements successfully is identified by the name of Nickel alloys.

In locomotives, in airplanes, in ships, automobiles, trucks and buses—in every type of modern vehicle—these Nickel alloys play a vital role...because they enable designer, engineer and manufacturer to suit the product more completely to present-day conditions and demands.

When Nickel is added to other metals in scientifically determined quantities, a wide range of improved properties results,—improvements that add longer life, reduce costs and make scores of new applications possible.



NICKEL ALLOY STEEL

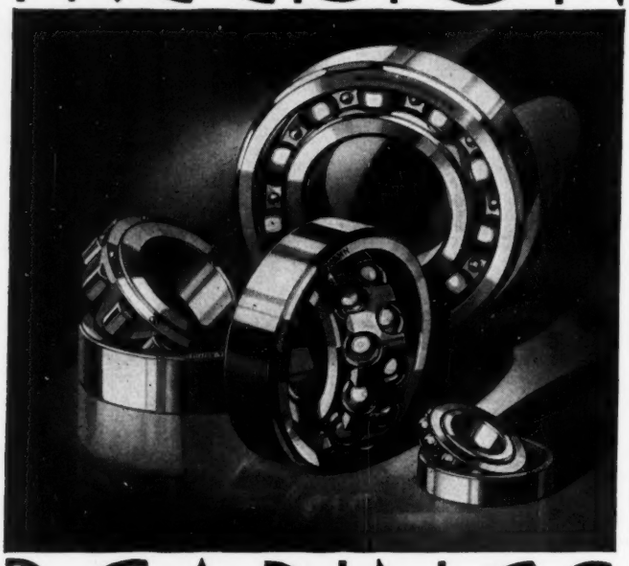
Among the most widely used Nickel alloys are the Nickel Steels. Above is shown a typical crankshaft, master rod, link rod and pin made from Nickel Alloy Steel for use in one of the leading aircraft engines. These steels are specified for such highly stressed parts by practically all aircraft engine manufacturers both in America and Europe.

Not only in transportation but in every field where man uses metals, there is a commercial Nickel alloy that can be employed to fill some particular role more efficiently and more cheaply.

We have an extensive library of data on the uses of Nickel alloys, and will be glad to send you full information on any application. Our engineers have broad experience in the solution of problems involving the use of Nickel. You may feel free to consult them at any time regarding your specific requirements.

THE INTERNATIONAL NICKEL COMPANY, INC.
Miners, refiners and rollers of Nickel.
Sole producers of Monel Metal.
67 WALL STREET NEW YORK, N. Y.

PRECISION



BEARINGS

PRECISION—as the term defining the characteristics distinctive of NORMA-HOFFMANN Bearings—comprehends ALL those qualities which reveal themselves in higher anti-friction efficiency, greater speed-ability, better performance, longer life, fewer replacements, improved production. ✲ ✲ ✲ These are the definite and tangible gains which accrue to the builder and user of any machine in which NORMA-HOFFMANN PRECISION Bearings are incorporated. ✲ ✲ ✲ Write for the PRECISION Bearing Catalogs. ✲ ✲ ✲ Let our engineers work with you—without obligation.

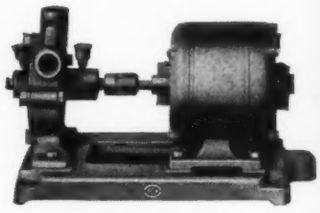
"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORP., STAMFORD, CONN., U. S. A.

herewith, with speeds from 500 to 98 revolutions per minute, and the right angle shaft type with speeds from 200 to 11 R.P.M. The fractional horsepower gear-motors utilize the planetary type of gearing with concentric shafts in the smaller ratios and worm gears either single or in combination with the planetary type in the higher ratios. Textolite pinions, helical gears and quiet running worm gears are used.

Pumps Have Taper-Edge Impeller

TURBINE pumps in a complete new line suitable for handling small quantities of liquids efficiently at high heads are being manufactured by Roots-Connersville-Wilbraham, Connersville, Ind. Capacities range from 5 to 300 gallons per minute at heads up to 350 feet. Included among the advantages claimed for the pump is a patented taper-edge impeller which gives the ability to vary the quantity while the pump is running. There is a slight increase in capacity as the head falls, with a noticeable decrease in power consumption.



Pumps can be incorporated as integral units in other equipment by employment of special mounting

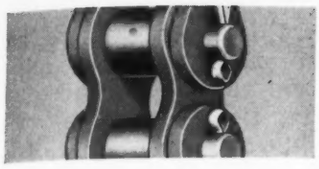
Both suction and discharge openings are located in the main pump housing, thus facilitating disassembly for cleaning without disturbing the pipe connections. The pumps can be furnished in corrosion resisting metals or alloys. Special mountings can be provided where these pumps are to be incorporated as integral units in other equipment.

Steel Pulley Line Expanded

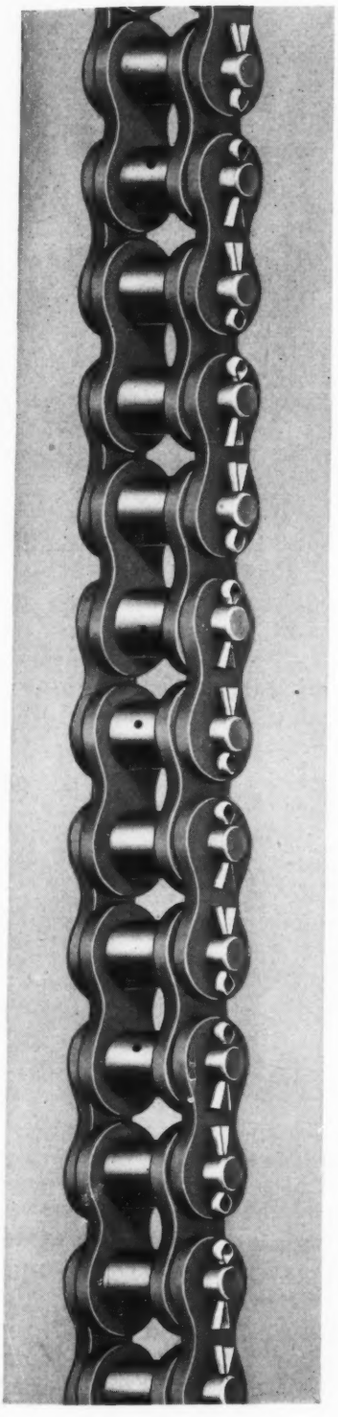
WEDGBELT pulleys of pressed steel in the larger diameters have been added to the line manufactured by American Pulley Co., Philadelphia. These new pulleys utilize the hub and arm construction, mounting the steel grooves upon the pulley face. The construction is said by the company to permit true running with greater power efficiency and longer belt life.

Splash Proof Motors Announced

SPLASH proof motors especially designed for use in breweries, dairy plants and similar locations where water or other liquids may be



AT THE MUSEUM OF SCIENCE AND INDUSTRY



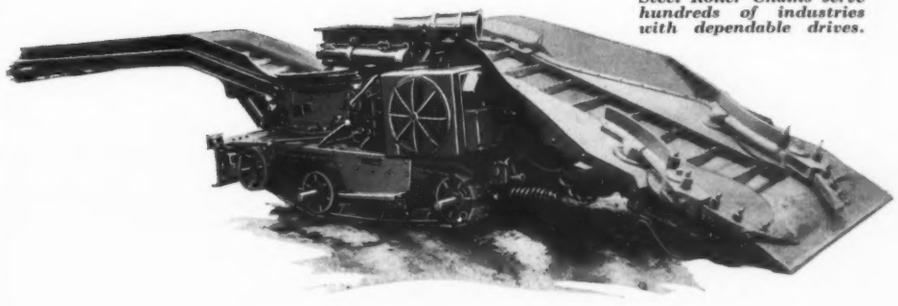
BALDWIN EQUIPPED JOY COAL LOADER

THERE will be many points of interest in Chicago in addition to the spectacular and educational Century of Progress Exposition during 1933. A full-sized operating bituminous coal mine initiates the opening of the Museum of Science and Industry in Jackson Park.

Various types of bituminous mining will be demonstrated. A modern mine hoist, skip, ventilating system, car dump, drills, short wall cutter, arc wall cutter loader, gathering locomotive, motor generator, pump and other equipment essential to present-day methods of coal mining will be operating under actual working conditions.

A Joy 5 BU Loader represents the modern coal loading method now successfully employed by many of the leading coal operators. This compact, safe, economical unit will demonstrate its ability to load more coal at lower cost just as it has done for operators in all of the bituminous coal producing states.

We are proud to feature this equipment and this performance because the Joy Manufacturing Company has been kind enough to say that Baldwin Chains used exclusively in their equipment have played an important part in the success of Joy Coal Loaders.



Baldwin-Duckworth Alloy Steel Roller Chains serve hundreds of industries with dependable drives.

BALDWIN-DUCKWORTH CHAIN CORPORATION

SPRINGFIELD, MASS.

Factories at Springfield and Worcester, Mass.

Belden

Soft Rubber Plugs Outlast the Appliance

Whatever the tool, appliance, or electrical device, there is now a Belden Unbreakable Soft Rubber Plug, Connector, or Socket for trouble-proof service. Belden Unbreakable Soft Rubber Plugs with standard or special blades, in black or special colors, are now available.

Belden Plugs and Connectors are furnished already attached to rubber sheathed portable cord, lamp cord, heater cord, and all other types of flexible cords. Every Belden wire meets Underwriters' requirements and bears Underwriters' safety label.

National advertising is boosting public acceptance of the Belden Soft Rubber Plug. Make your tools and appliances trouble-proof and easier to sell by equipping them with this griefless sales feature. Write today for sample and quotation on your requirements.

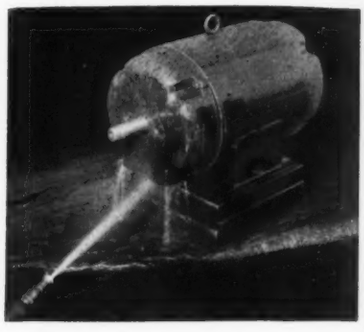
Belden Manufacturing Co.
4639 W. Van Buren St. : : : Chicago

SAFE Electrical Cords
CARRY THIS LABEL
UNDERWRITERS LABORATORIES INSP CORD

Belden
Soft Rubber Plugs on Safe Cords
for every type of electrical appliance or service

splashed on the motor have been brought out by Ideal Electric & Mfg. Co., Mansfield, O. The motor also is suitable for use where the equipment is frequently washed down with a hose as a stream of water striking the motor at any angle will not wet the motor windings.

Baffles placed in the air ducts remove spray from the air entering the motor and keep the windings dry. The motors are made in all sizes from 1 to 200 horsepower as squirrel cage motors and meet all classifications of torque and inrush requirements.



Baffles placed in the air ducts remove spray from the air entering motor

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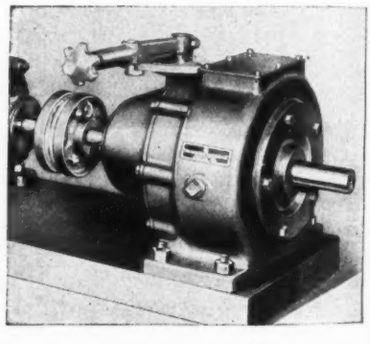
Clutches Transmit Power in Reducer

STRICTLY a mechanical device, the Johnson variable reducer, distributed by Smith Power Transmission Co., 1213 West Third street, Cleveland, does not operate under sliding or rolling friction. The unit, shown herewith, is composed of five oneway overrunning clutches; the five clutches transmitting power to uniform cycles to a centrally mounted driven gear. The driven gear is mounted on a hardened and ground output shaft which in turn is mounted on two ball bearings. Power may be taken from the output shaft through a coupling, sprocket and chain, sheaves and V-belt, pulley or any other type of drive.



Five one-way overrunning clutches transmit power in new variable reducer

Output speed ranges from zero to 240 revolutions per minute. Speed changes are accomplished by changing the stroke of the five arms

WE REPEAT:

"Three years ago very few companies had a definite plan prepared with which to meet a possible recession in business. How many are there today who are really prepared for an increase?"*

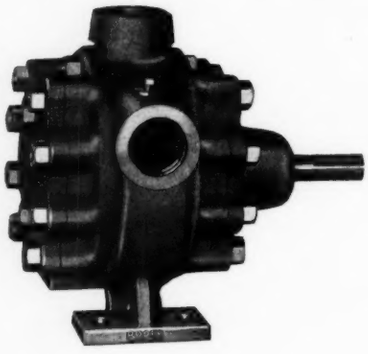
**Reprinted from the August 1932 issue of MACHINE DESIGN*

ROPER

TRADE MARK

(Builders of Pumps Since 1857)

Pumps For All Purposes



Hydraulic:

A complete line of Hydraulic Pressure Pumps for actuating machine tools, road machinery, elevators, lifts, stokers, etc. Wide variety of sizes, capacities, and mounting designs. Types for either lubricating or non-lubricating liquids. Pressures up to 1,000 lbs.

General Industrial:

Large and small capacity pumps for thick liquids or thin—acids or alkalies—corrosive or combustible. Pumps for machine tools; for soap, glue, rubber, dye and chemical works; for textile plants; for molasses, liquid foods, asphaltum, grease, brine, gasoline, lacquer, beer. Skilled engineering and production forces to produce what you want.

Coolant:

One way and reversible types with wide range of capacities and flexibility of mounting design,—for all types of machine tools. With or without built-in relief valves. Only two moving parts. Positive delivery; smooth, forceful, non-pulsating flow.

Hand Transfer:

Portable or permanent attachment to any type of container. For light or heavy liquids. Also non-ferrous, non-sparking, non-corrosive hand pumps which are fire proof, vapor-proof and explosion-proof.

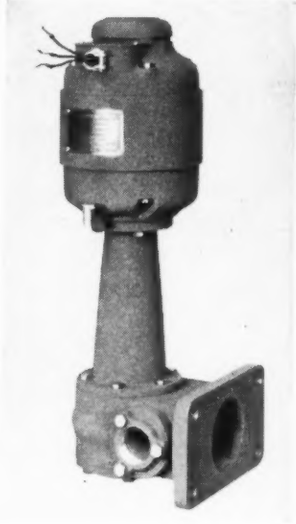
Geo. D. ROPER Corp. — Rockford, Ill.

PUMPS

attached to the one-way clutches. This change is made by a simple variable throw crankshaft arrangement controlled by the hand lever.

Develops New Vertical Pumps

TWIN suction intake, accomplished by two separate compartments communicating independently with the lower and upper sections of the impeller, is a feature of the vertical motor driven pumps brought out by Ruthman Machinery Co., Cincinnati, O. These compartments are of equal size and maintain hydrostatically balanced thrust with increased capacity. Self-cleaning is accomplished automatically, when the flow is partially or entirely throttled, by an internal agitation which exerts a pressure outwardly through the intakes.



Air cooled motors are employed on vertical pumps which have twin suction intakes and a reversible housing for the impeller

A reversible impeller housing permits changing the relation of the intake with the discharge to either right or left hand. Air cooled motors are used, and conduit outlets are cast integral with the upper motor flange.

Magnetic Clutch Is Unusually Small

ONLY 3 inches in diameter and weighing 3½ pounds net, the new clutch added to the line manufactured by Magnetic Mfg. Co., Milwaukee, is said to be the smallest diameter magnetic clutch ever made commercially. In spite of the size of the clutch, shown herewith, it is of rugged and compact construction. It is simple in design and can be used on any drive requiring automatic or manual clutching. The collector rings are mounted on the outside diameter to conserve space on the shaft, but also can be placed on a hub extension of the field member. A standard brush holder assembly

(if you have the combination)

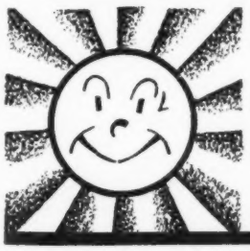
Isn't it always fair weather and don't good fellows get together when the equipment you design operates with an absolute minimum of breakdowns? Your customers praise you, the boss smiles benignly upon you and you even give yourself sly pats on the back—right?

NOW—here's the simple combination that insures the fair weather: Alemite High Pressure Lubrication Systems PLUS Alemite Industrial Lubricants.

The first you no doubt have been designing into equipment, lo these many years. (No designer can call himself a designer these days who leaves lubrication to grease cups and oil holes. Is there a challenge on that?)

The second is equally and as vitally important. *Only Alemite knows how to produce the lubricants which will operate at top efficiency in its lubrication systems!*

THEREFORE—specify the exact type of Alemite Lubricants which must be used to get the maximum efficiency out of your equipment! If for no other reason, do it in self defense. *The finest designing in the world can be quickly upset by inferior "greases" and oils.*



ALEMITE CORPORATION (Division of Stewart-Warner) 751
1890 Diversey Parkway, Chicago, Illinois
Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name.....

Company.....

Address..... City..... State.....

PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

ALLEN

TRI-MARKT

TRADE MARK

HOLLOW SCREWS

of

Chrome-

Mo-lyb-den-um

Be

sure of

stability

in your sources

of supply and your

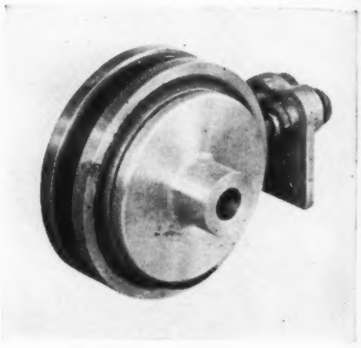
business friendships

"REFLATION" movements are affecting markets; reversing recent positions in buyer-seller relations. Depleted stocks put industrial consumers at disadvantage. Renewed demand, in many quarters, must be met with factory facilities eaten by obsolescence. These facts portend embarassment to the buyer who lacks well-laid connections with stable supply-sources. . . The Allen Company is bed-rocked in the position of a dependable producer equipped and determined to care for its customers, to their personal and economic advantage. « « «

THE ALLEN MFG. COMPANY

HARTFORD, CONN. U. S. A.

is included. The clutch will develop a torque equivalent to 40 inch pounds for continuous duty operation and requires fifteen watts di-

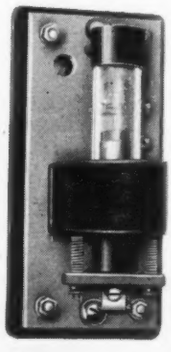


Unusually small magnetic clutch can be incorporated in design of machine

rect current for this service. Where direct current is not available, the part can be energized from a 110-volt alternating current circuit through the use of a small rectifier.

Mercury Switch Is Protected

A FUSED quartz cup at the point where the arc occurs and a rigid construction by virtue of bakelite caps cemented on the ends prolongs the life of the new Mercrelay, a new type of mercury circuit controller, designed by Gen-



Mercury circuit controller is safe in the presence of combustible gas or flammable material as the spark is entirely enclosed

eral Wire & Switch Co., 140 Benedict street, Providence, R. I. The unit, which can be supplied in both normally open or normally closed types, is safe in the presence of combustible gas or flammable material.

Alloy Is Acid Resistant

DURICHLOR, a new alloy manufactured by Durion Co. Inc., Dayton, O., is almost entirely resistant to hydrochloric acid at all concentrations and all temperatures up to the boiling point. The material is being used to make pumps, valves, pipe, fittings, jets, etc.

There is Profit for you in the Experience of these men!

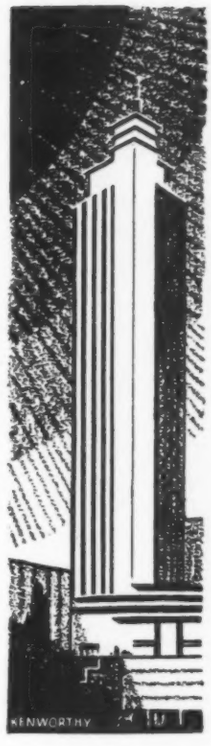
Never before has the experience of successful sales promotion executives meant so much! Never before have the lessons to be learned been so valuable!

The minds that the N.I.A.A. has gathered together for the coming "Industrial Marketing Conference" in connection with Engineers' Week and A Century of Progress have a message of help for YOU. They have a story of proven sales and advertising success during the tragic years of 1931 and 1932.

Look over these names and plan to hear these men!

W. L. Rickard, Pres., Rickard & Co.
A. C. Nielsen, Pres., A. C. Nielsen Co.
Bennett Chapple, Vice-Pres., American Rolling Mills Co.
Donald R. Dohner, Dir. Art, Eng. Dept., Westinghouse Elec. Co.
L. S. Hamaker, Sales Promotion Mgr., Republic Steel Corp.

These are but a few of the many that will discuss advertising, sales promotion, marketing methods and their relation to existing conditions and the future of selling. These men know their subject and have solutions to problems similar to yours. To hear them is to profit!



—And your Special Problems will get Special Attention!

Clinic talks will discuss actual campaigns, reasons why, and objectives desired. There will be booths where subjects dealing with sales presentation, the planning and making of sales manuals, the problem of the house organ, the obtaining and selling of construction leads, translating inquiries into sales, etc., may be discussed at leisure with those that have been studying these subjects for weeks, and are fitted to be a real help to you. An advertising exhibit will treat the campaigns that have run during the year. There you can see what your competitor is doing in its entirety.

Plan now to come! See the Fair—visit the many conventions during Engineering Week—stay for the Midwest Power Show and live at the beautiful Medinah Athletic Club with all its pleasant facilities.

We are in a position to make arrangements to ease your stay for the Fair. Let us help you.

June 26 to 28! We expect you! Write for details.

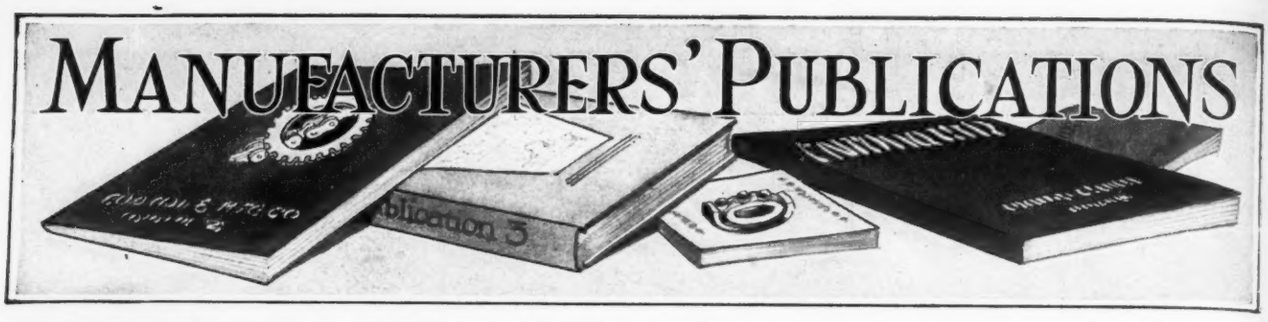
TIE THESE TOGETHER IN ONE BIG WEEK—

National Industrial Advertisers Association Industrial Marketing Conference
Engineering Week
Midwest Power Show
A Century of Progress
Chicago, the Summer Resort

JUNE 26-28

NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION

National Headquarters — 537 S. Dearborn St.
CHICAGO



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (IRON)—Meehanite Metal Corp., Chattanooga, Tenn., has published a bulletin entitled "The Engineer Investigates Meehanite," which presents graphically the physical properties, casting problems, accuracy, production time, service qualities and machinability of that metal. The bulletin also presents micrographs to show the structure of the metal.

BASES—Motor bases which combine sound insulating and belt adjusting features are covered in catalog insert GEA-1714 of General Electric Co., Schenectady, N. Y.

BEARINGS—Engineering data for roller bearings using small diameter rollers has been compiled in booklet form by Bantam Ball Bearing Co., South Bend, Ind. In addition to a complete coverage of the technical phases of the subject, the booklet includes load charts and drawings showing applications.

BERYLLIUM COPPER—Riverside Metal Co., Riverside, N. J., is distributing a booklet descriptive of beryllium copper, a heat treatable copper alloy available in sheet, strip, wire or rod form.

BRONZE—Shenango-Penn Mold Co., Dover, O., is issuing additional data sheets which include a quick reference for finding the alloy for a specific use, helpful suggestions to assist the company in quoting and a complete description of eight alloys.

CAST PARTS—Stainless steel castings for corrosion resistance are discussed in the first issue of *Ladle Sparks*, published by Sivyer Steel Castings Co., Milwaukee. The booklet includes a table of representative physical properties of annealed and heat treated steels and typical chemical composition of standard and alloy steels.

DRIVES—Electric motor drive speed reducers are presented in a recent leaflet prepared by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

DRIVES—Single A groove sheaves and single B groove sheaves are discussed in a bulletin of American Pulley Co., Philadelphia, which gives complete information on pulley sizes and corresponding belt sizes.

FASTENINGS—Rivet-bolts are the subject of bulletin No. 11, prepared by Dardelet Threadlock Corp., New York.

MOTORS—General Electric Co., Schenectady, N. Y., has prepared catalog insert GEA-1695 on its line of quiet induction motors.

MOTORS—Descriptions, properties and range of units available in the line of Varidrive motors manufactured by U. S. Electrical Mfg. Co., Los Angeles, is given in catalog inserts of the company.

MOTORS—Splash proof motors manufactured by Century Electric Co., St. Louis, are covered in a publication of the company, which gives details of how the motor is protected and cross sectional views.

PUMPS—A complete new line of turbine pumps suitable for handling small quantities of liquids efficiently at high heads is described in bulletin 260-B10 of Roots-Connersville-Wilbraham, Connersville, Ind. Capacities range from 5 to 300 gallons per minute at heads up to 350 feet.

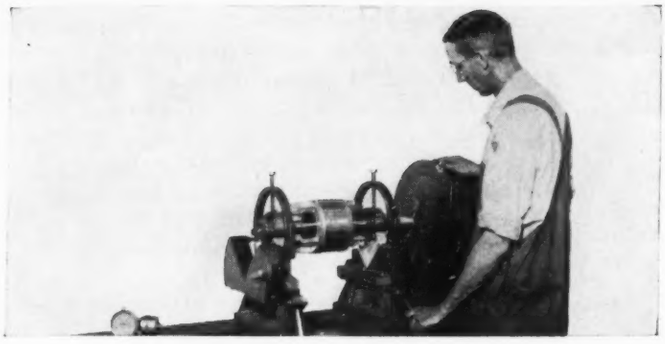
SHAPES—Keystone Drawn Steel Co., Spring City, Pa., has published a booklet describing the manufacture of cold finished steels, their uses, physical and chemical properties and other data and tables pertaining to this commodity. Special drawn shapes are covered in this booklet.

Research Publications

The Performance of Propeller Fans, by A. I. Brown. Observations are based on tests of fifty or more fans. Data are presented for 21 tests of 15 fans of various makes, which represent a variety of designs and sizes ranging from approximately 12 to 28 inches in diameter. Published as Engineering Experiment Station bulletin No. 77 by Ohio State university, Columbus, O. 33 pp. 25 cents.

The Surface Tension of Type-Metal Alloys, by H. Vance White. Material of a general nature brought out in this research include the development of a simple procedure for testing surface tension and test results and conclusions which may be applied to metals other than those actually investigated. Published as bulletin No. 13 of Engineering Experiment Station, Virginia Polytechnic institute, Blacksburg, Va. 35 pp.

Tensile Properties of Cast Nickel-Chromium-Iron Alloys and of Some Alloy Steel at Elevated Temperatures, by William Kahlbaum and Louis Jordon. Tensile properties were determined by short-time tests for a medium manganese carbon steel at 900 degrees Fahr.; for a series of cast nickel-chromium-iron alloys containing about 0.5 per cent carbon, 35 per cent chromium and from 10 to 45 per cent nickel at a temperature of 1550 degrees Fahr.; and for three tungsten-chromium-vanadium steels and four molybdenum-chromium-vanadium steels at temperatures of 850 and 1000 degrees Fahr. Published as RP 474 by bureau of standards. Available through Superintendent of Documents, Government Printing office, Washington. 6pp. 5 cents.



Dynamic balancing machine for rotors—has special new indicators.

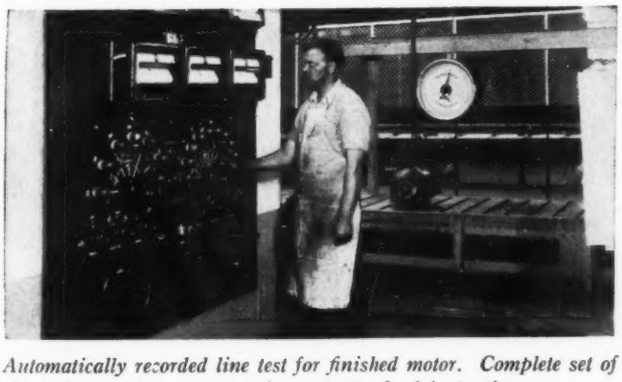
Checking vibration on finished motor. The special vibrometer indicates vibrations as small as .001 in amplitude.

If you only could *visit* the plant . . . !

● We are certain it would be a revelation to you of how far and into what detail this organization is willing to go in putting into a motor the last possible refinement to secure added years of service.

No detail is too small. No precaution is too troublesome!

In this huge F-M plant you will find every modern device—every combination of skilled worker and instrument—all engaged in those precision operations which are necessary to make F-M Motors come up to F-M exacting standards of quality.



Automatically recorded line test for finished motor. Complete set of charts from meters accompanies motor to final inspection.

Take this question of vibration: Each rotor is individually tested on dynamic balancing machines with sensitive neon indicators. The slightest indication and the *same* operator makes the necessary *permanent* compensation—and then re-tests. Laboratory methods? Certainly!

Then the assembly—and *again* a special vibrometer checks *a vibration amplitude as low as* .001 *inch.*

Truly a revelation in motor building precision—but also an evidence of the policy which has contributed so much to the making of better motors—for this same organization pioneered the ball-bearing motor. This organization was the first to stress *mechanical* as well as *electrical* excellence in motor making. It is the policy of a company with a firm determination that the F-M motor will serve longer and represent the highest value obtainable for your investment.

We shall be pleased to send detailed information on F-M motors without obligation.

FAIRBANKS-MORSE
MOTORS

POWER PUMPING AND WEIGHING EQUIPMENT

5892-EA40-53

Rear Engine Shows Promise

(*Concluded from Page 22*)

when the car is subjected to force or impact in the plane of one axle, whether vertically or horizontally, there will be no corresponding reaction in the plane of the other. A considerable improvement in both comfort and freedom from skidding inevitably follows the adoption of this principle as a feature of design, he contends.

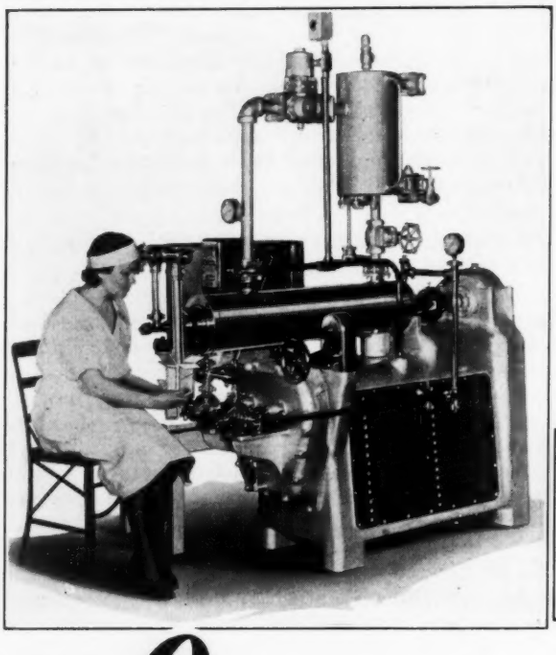
In the orthodox car the value of AB is not equal to K^2 but usually to something between $1.5K^2$ and $2.7K^2$. Considering that the front wheels of such a vehicle are passing over a bump, they are forced upward, compressing the front springs and rotating the body of the car as a whole about some point much nearer the center of gravity than the plane of the rear wheels. Thus the part of the frame immediately over the rear wheels swings downward, compressing the rear springs. By this time, however, the rear wheels themselves have reached the same obstruction and are subjected to an upward impulse, so that the effect of every inequality of the road surface is intensified on the rear wheels.

As shown in Figs. 1 and 2, the clutch N and speed change gearing O are on the opposite side of the axis of the rear wheels from the engine. This is essential in securing a weight distribution such that the center of gravity X is one-third of the length of the wheel base. Another advantage in having the gear box and clutch ahead of the rear axle lies in the fact that the control rods or wires leading to the driver's compartment are shorter than otherwise would be possible.

Unique is the drive, Fig. 1, which is effected from the differential gearing C to the rear wheels by independent shafts D which are jointed universally at points E and F. Springs extend transversely of the vehicle and are connected to the chassis through a saddle G. Ends of upper and lower pairs of arms H are pivoted to the top and bottom of blocks J. Axes of the pivoting arms are horizontal and extend longitudinally, the upper and lower arms H being parallel so that wheels L are maintained in their normal upright position under all flexing conditions of springs M.

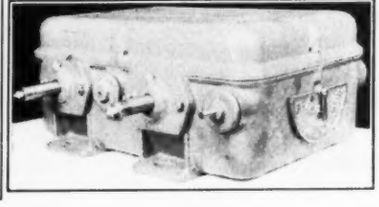
Numerous other features are incorporated by Mr. Burney and although some French automotive engineers attempt to show why the rear mounted engine is not the best solution to the problem of general layout of the passenger car chassis, his ideas give promise of blazing a trail toward more efficiency, comfort and economy.

The LEWELLEN Variable Speed Transmission



is incorporated in this Vogt Instant Ice Cream Freezer, manufactured by Cherry Burrell Corporation, Cedar Rapids, Iowa. This is the Series 100, fully enclosed type, completely protecting all working parts of the Transmission from acids, water, etc. The Lewellen Transmission controls the speed of the pumps which feed the material into the freezing cylinder. The process is continuous, the ice cream mix being pumped into one end of the freezing cylinder, and coming out in a continuous stream of perfect ice cream at the delivery end.

Your product will be more efficient and more valuable to your customers, if you incorporate the Lewellen Transmission to insure accurate variable speed control.



Let us tell you about the superior features found only in the Lewellen. No cost or obligation.

THE *Lewellen* MANUFACTURING CO.
COLUMBUS, INDIANA

"It costs no more to have the best."